



SCHOOL OF MECHANICAL ENGINEERING

B.Tech

Mechanical Engineering

HAND BOOK 2020-24

RUKMINI EDUCATIONAL Charitable Trust

www.reva.edu.in



SCHOOL OF MECHANICAL ENGINEERING

HANDBOOK B. Tech. in Mechanical Engineering 2020 Scheme Applicable for 2020-24 Batch

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Chancellor's Message

"Education is the most powerful weapon which you can use to change the world."

"Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the south tat is curious enough to go look for it. Technological boons enable information availability anywhere aryntime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and imellectually eller. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both deucational and eater-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author, magnificently demonstrates the importance of ambience in facilitating focus



Pro-Chancellor's Message

REVA University is most sought-after destination for higher education in the major streams of engineering, science, commerce, management, architecture, law, arts and humanities. University practices modern tools and ICT based technologies that focus on digital learning, project-based learning, personalized learning, etc. Educational reforms are adopted in terms of STEM education, teacher professional development with good mix of diversity and inclusivity.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. CBCS corress also provide knowledge on local, regional, national and global level issues along with enabling them to be employable and also aid to incutate enterpreneurial skills across all the programs. Ample of opportunities are given for students to enhance their skill-sets through value added courses.

The current trends in engineering education engineering profession in the next two decades will undergo dramatic changes, driven by not only technological developments but also societal transformation. Besides increased globalization, more acute concern for environment for sustainable development will characterize changes and challenges for future engineers in their roles.

REVA University is fully prepared to all such challenges for future engineers in their roles.

Mr. Uness S Raju Pro Chancellor REVA University as one of next generation globally recognized education hub.

Mr. Uness S Raju Pro Chancellor REVA Unive



Vice Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards interdisciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and Industry.

A strong believer and practitioner of the dictum "Knowledge is Power", RRVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawing 49 sores of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conductive to higher teaching-learning emrironment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The fresibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of students from the internations of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, continuous assessment with grad

programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character -that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr. M. Dhanamjaya Vice-Chancelor REVA University of the portal of REVA University (REVA University).

Port M. Dhanamjaya Vice-Chancelor REVA University.

Port M. Dhanamjaya Vice-Chancelor REVA University.

With great pleasure, I welcome you to the School of Mechanical Engineering at REVA University. The School offers Undergraduate programs in Mechanical Engineering, Mechatorins: Engineering and Aerospace Engineering leading to B. Erch. Degree in Machine Design. More than 1500 students representing various parts of India as well a few students from overseas study at our School. The School has more than 60 well qualified and experienced faculty members. The School has more than 60 well qualified and experienced faculty members. The School has more than 60 well qualified and experienced faculty members. The School has more than 60 well qualified and experienced faculty members. The School has more than 60 well qualified and experienced faculty members of thouses facilities, in addition to excellent facilities for recreation and sports. Students are encouraged to live on campus to have better campus sepretine eard our houset facilities are second to none.

We understand that the students come to university for learning and the School focuses on enhancing the efficiency of learning of students and also achieving the learning outcomes to pursue careers in modern day industries. To improve efficiency of learning the School has successfully adopted modern day pedagogical methods like project based learning, problem based learning, blended learning, flipped class rooms, experiental learning and created digital resources for students to access and experience. The Faculty members of the School continuously upgrade their pedagogical methods and knowledge to be in par with the best in the Country. Our students are very successful in developing and demonstrating technologically advanced projects during their final year.

Our masters and PhD Scholars work on scientifically and technologically advanced topics in mechanical design, engineering analysis, manufacturing of mechanical and mechatoric systems and publish their research findings in international journals of repute.

The curriculum caters to and has relevance to Local, R

It was the dream of late Smt. Rukmini Slyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. Rukmini Educational Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science, Educational Institutions comprising of REVA Institute of Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Science and Management (RISM), REVA Institute of Science and Management (RISM), REVA Institute of Management (RISM), REVA Institute of Science and Management and Science, Legal Studies, Management and Science (RISM), REVA Institute of Science and Management (RISM), REVA Institute of Science and Science Scien

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karmataka and notified in Karmataka State Gazette No. 80 dated 27th ebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec. 22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to repeate students with knowledge, wishon and patriosism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 50 acres of land and equipped with state-of-the-art infrastructure that provide conductive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-bulk teaching facilities, Hully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, facility members and supportive staff.

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of fignineering. Management, Law, Science, Commerce, Arts, Performing Arts, and Research Studies. REVA Offers 41 Undergraduate Programmes, 31 Postgraduate Programmes in various disciplines.

The curriculum of each programme is designed with a keen eye for detail by giving emphasis on handson training, industry relevance, social significance, and practical applications. The University offers world-class facilities and education that meets global standards.

The programs being offered by the REVA University are well planned and designed after detailed

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and innovation division headed by a senior protessor as Dean of Research and innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D institutions, industries and fractury members of RAV University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Dara Mining, Gloud Computing, Image Processing, Network Security, VSI and Embedded Systems, Wireless Censor Networks, Computer Networks, LOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Mano-technology for coatings, Composites, Urbardon Enregles, Electric Vehicles, Multiliveel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photoe electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Huid Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, effects of Swill Development and Placement (CDC) department with world class infrastructure, headed by a dynamic esperienced Professor & Dean, and supported by well experienced Training, comparison, computer Assisted Language Teaching, Culture Studies to the infaultion of the professor

headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N. R. Narayana Murthy, Founders and Chairman and Mentor of Infosys, Dr. K. Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director ilise, and noted Scientist, Dr. V. S. Ramamurthy, Former Secretary, DST, Government of India, Dr. N. X. Aatre, noted Scientist, Dr. V. S. Ramamurthy, Former Secretary, DST, Government of India, Dr. N. X. Aatre, noted Scientist, Dr. V. S. Ramamurthy, Former Secretary, DST, Government of India, Dr. N. X. Aatre, noted Scientist and former head of the DROD, and Scientific Advisor to the Ministry of Defense, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

REVA organizes various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute inovative ideas for the progress of the society. One of such cultural events is REVOTSAVA conducted every year. The event not only gives opportunities to our students of REVA – Sub at also students of other Universities and Colleges. During three days of this me

Vision of REVA University

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral valves, research culture and innovative skills through higher education of global standards

Mission of REVA University

1. To create excellent infrastructure facilities and state-of-the-art laboratories and incubstion centers

2. To provide student-centric learning environment through innovative pedagogy and education reforms

3. To promote industry-institute partnerships and share knowledge for innovation and development

4. To promote industry-institute partnerships and share knowledge for innovation and development

5. To promote industry-institute partnerships and share knowledge for innovation and development

6. To enhance leadership qualities among the youth and enrich personality traits, promote patriotism and moral values.

Objectives of REVA University

9. Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines

9. Smooth transition from teacher-centric focus to learner-centric processes and activities

9. Experiments at the functions of interest to its major constituents like faculty, staff, students and the society to reach leadership position

10. Developing a sense of ethics in the University and Community, making it conscious of its obligations to the society and the nation

10. Accepting the challenges of globalization to offer high quality education and other services in a competitive manner

ABOUT SCHOOL OF MECHANICAL ENGINEERING

Mechanical Engineering is one of the oldest and classical branches of engineering which drives the development and economy of the country. The school of Mechanical Engineering in REVA University has a rich blend of experienced, energetic and dedicated faculty with highest qualification in the specialization of thermal, design, manufacturing and management streams. The school is having well-furnished class rooms and well equipped laboratories with modern software tools to meet academic and industry requirements. The research Centre with modern equipment's and testing facility is also available to cater research activities in the field of materials and bio-fuels. The school is conducting extracurricular and co-curricular activities to develop additional stills, knowledge and condindence through University Industry Interaction Cell and various student clubs and student chapters with the support of industries. Industry persons are invited to give technical talks on latest technologies and students are deputed for internship in industries and universities in India and abroad for internship, research and twinning program or higher studies which will give more exposure of our students to outside world. Many students have done internship in reputed institutions like list, CISO, DRDO, HAL, Rail Wheel factory, Volvo and many more. Every sensels exhole is organizing industry visits to reputed institutions to learn various aspects of industry. The school is shaving clubs and chapters which are MARS, ISHRAE Student Chapter, Foundry man Society, Fluid Power Society, Sincolic Stociety, Tribology society, Robotics CAI, SAE club and Anya Rosing Team through which cultural events, training programs, invited talks, industry visits and placement activities are conducting. School is encouraging the students to learn additional skills like design, team management, time managem

Vision of School of Mechanical Engineering

"Aspires to be recognized globally for outstanding value based education in mechanical and allied areas and research leading to well qualified engineers, who are innovative, entrepreneurial, successful in their career and committed to the development of the country."

Mission of School of Mechanical Engineering

• To impart quality education to the students and enhance their skills to make them globally competitive engineers in mechanical and allied areas.
• To pronote multidisciplinary study, cutting edge research and expand the frontiers of engineers' profession in mechanical and allied areas.
• To create state-of-or-facilities with advanced technology for providing students and faculty with opportunities of introducion, application and dissemination of knowledge.
• To prepare for critical uncertainties shead for mechanical engineering and allied areas and to face the challenges through clean, green and healthy solution.
• To collaborate with industries, institutions and such other agencies nationally and internationally to undertake exchange programs, research, consultancy and to facilitate students and faculty with greater opportunities for individual and societal growth.

Ref: 805/SME/RME-2009-31-20.08-200/2011-22-26-86-11/2022-23-35-86-27/2022-24-18.08-23

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		ADVISORY BOARD OF SCHOOL OF MECHANICAL ENGINEERING	
	SI. No.	Details of Members	
	1	Dr. N. V. Ravikumar, Associate Professor, Department of Metallurgy & Materials Engineering, IIT Madras, Chennai.	
	2	Mr. K. N. Narsimha Murthy Chairman, Fluid Air Systems, Bengaluru. Hon. Treasurer, Karnataka Small Scale Industries Association (KSSIA)	
	3	Prof. M. V. Krishna Murthy Former Professor, Dept. Mechanical Engineering, IIT Madras, Chennai, Former Director, VIT, Vellore.	
	4	Mr. Praveen Kumar Jinde, Scientist, NAL, Bengaluru.	
	5	Dr. K Ramachandra Former Director, GTRE, Bangalore CEO, NP-MICAV's National Design Research Forum The Institute of Engineers, Bengaluru.	
	6	Prof. E. Abhilash Dept. Mechanical Engineering, King Khalid University Abha, Kingdom of Saudi Arabia.	
	Ref: BOS/SM	ADVISORY BOARD OF SCHOOL OF MECHANICAL ENGINEERING Details of Members Dr. N. V. Ravikumar, Associate Professor, Department of Metallurgy & Materials Engineering, IIT Madras, Chennai. Mr. K. N. Narsimha Murthy Chairman, Fluid Air Systems, Bengaluru. Hon. Treasurer, Kannataka Small Scale Industries Association (KSSIA) Prof. M. V. Krishna Murthy Former Professor, Dept. Mechanical Engineering, IIT Madras, Chennai, Former Director, VIT, Vellore. Mr. Praveen Kumar Jinde, Scientist, NAL, Bengaluru. Dr. K Ramachandra Former Director, GTRE, Bangalore CEO, NP-MICAV's National Design Research Forum The Institute of Engineers, Bengaluru. Prof. E. Abhilash Dept. Mechanical Engineering. King Khalid University Abha, Kingdom of Saudi Arabia.	
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Program Overview

Mechanical Engineering is a discipline of engineering that applies the principles of physics and materials science for design, analysis, prototyping, manufacturing, and maintenance of mechanical systems. Mechanical engineering deals with inter conversion of thermal and mechanical power and the design, production, and operation of machines and tools. It is one of the oldest and broadest engineering disciplines.

The mechanical engineering field requires an understanding of core concepts including mechanics, kinematics, thermodynamics, materials science, and structural analysis. Mechanical engineers use these core principles along with tools like computer-aided engineering and product lifecycle management to design and analyse manufacturing plants, industrial equipment and machinery, heating and cooling systems, transport systems, aircraft, watercraft, robotics, medical devices and more.

Mechanical Engineering science emerged in the 19th century as a result of developments in the field of physics. The field has continually evolved to incorporate advancements in technology. Mechanical engineers today are pussing developments in fields was a composites, mechatoricis and micro and nano technology. Mechanical Engineering overlaps with aerospace engineering, civil engineering, electrical engineering petroleum engineering and chemical engineering to varying amounts.

There is tremendous scope for mechanical engineering and chemical engineering, cement industry, steel, power sector, hydraulics, manufacturing plants, drilling and mining industry, petroleum, aeronautical, biotechnology and many more. Nowadays they are also increasingly needed in the environmental and bio medical fields. There are exciting times abaced for mechanical engineers as transport technologies like hyper loop, electric vehicles, flying cars, drone technologies, intelligent system like robots and additive manufacturing including bios protings are gaining importance.

The School of Mechanical Engineering are REVA UNIVERSITY offers

Program Educational Objectives (PEO's)

The After few years of graduation, the graduates of B.Tech Mechanical Engineering will:

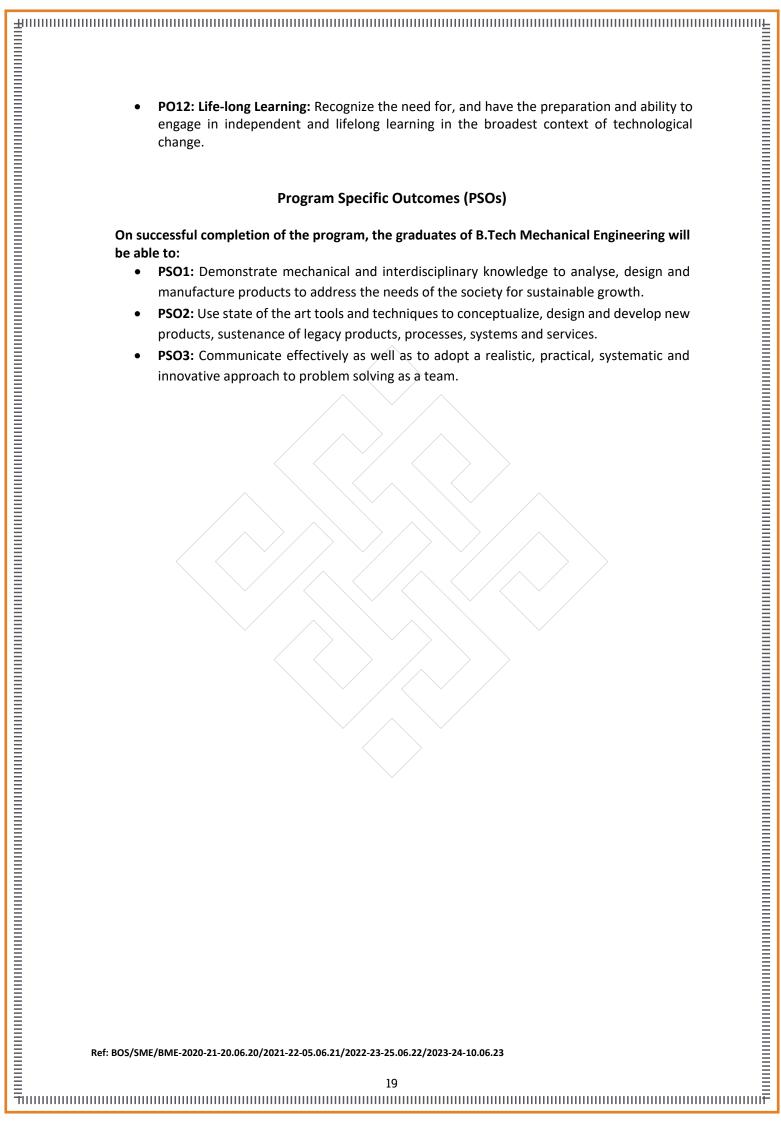
- **PEO1:** Design, develop, maintain and improve mechanical engineering systems with highest quality, economically feasible and socially acceptable.
- **PEO2:** Exhibit analytical, computational and experimental skills to address the challenges faced in mechanical and allied engineering streams.
- **PEO3:** Exhibit professionalism, ethical attitude, team spirit and communication skill and pursue lifelong learning to achieve career goals, organizational goals and societal goals.

Program Outcomes (POs)

On successful completion of the program, the graduates of B.Tech Mechanical Engineering will be able to:

- **PO1: Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, to solve mechanical engineering problems.
- PO2: Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
- PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

- PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems
- PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- **PO6: The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11: Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.





(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (avi) & (xxi) of the REVA University Act, 2012)

1. Title and Commencement:

1.1 These Regulations shall be called "REVA University Academic Regulations — B. Tech, Degree Program 2020-21 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of board of Management

1.2 These Regulations shall come into force from the date of assent of the Chancellor.

2. The Programs:
These regulations cover the following B. Tech., Degree programs of REVA University offered during 2019-20

B Tech in:
Bioelectronics Engineering
Covil Engineering
Computer Science and Information Technology
Computer Science and Engineering (Land MIL)
Blottcal and Electronics Engineering
Electrical and Computer Engineering
Electrical and Computer Engineering
Electronics and Communication Engineering
Mechanical Engineering
Electronics in Commission Science and Engineering Electronics and Communication Engineering
Electronics and Communication Engineering
Electronics and Communication Engineering
Electronics and Communication Engineering
Electronics and Communication Engineering
Electronics and Communication Engineering
Electronics and Engineering
Mechanical Engineering
Mechanical Engineering
Mechanical Engineering
Mechanical Engineering
Mechanical Engineering
Electronics and Engineering
Electronics and Eng

L	Lecture
Т	Tutorial
Р	Practice

Where:

L stands for Lecture session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much required skill component.

4.2 Classification of Courses

Courses offered are classified as: Core Courses, Open Elective Courses, Project work/Dissertation

- **4.2.1 Core Course:** A course which should compulsorily be studied by a candidate choosing a particular program of study
- **4.2.2 Foundation Course:** The foundation Course is a mandatory course which should be completed successfully as a part of graduate degree program irrespective of the program of study
- **4.2.3** Hard Core Course (HC) simply core course: The Hard Core Course is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates have to complete compulsorily
- 4.2.4 Soft Core Course (SC) (also known as Professional Elective Course)

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study

4.2.5 Open Elective Course (OE):

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an **Open Elective Course**

4.2.6 Project Work / Dissertation:

Project work / Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problems to solve a multivariable or complex engineering problems. The project will be conducted in two phases, phase-I (7th Semester), Consists of literature survey, problem identification, formulation and methodology. In Phase-II (8th Semester) student should complete the project work by designing or creating an innovative process or development of product as an outcome. A project work carrying TWO, FOUR or SIX credits is called Minor Project work / Dissertation. A project work of SIX, EIGHT, or TEN, credits is called Major Project work / Dissertation. A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned. But the Major Project shall be Hard Core.

4.2.7 "Program" means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma Degree or such other degrees instituted and introduced in REVA University.

5. Eli _l 5.1. The	gibility for Admission: e eligibility criteria for ac	Imission to B Tec	h Program of 4 years (8 Semesters) is given below:	
1	Bachelor of Technology (B Tech)	4 Years (8 Semesters)	Passed 10+2 examination with Physics and Mathematics as compulsory subjects, along with any one of the following subjects, namely, Chemistry, Bio-Technology, Computer Science, Biology, Electronics and Technical Vocational subject Obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together	
Ref: BOS	Bachelor of Technology (B Tech)	Lateral entry to second year	Eligibility Passed 10+2 examination with Physics and Mathematics as compulsory subjects, along with any one of the following subjects, namely, Chemistry, Bio-Technology, Computer Science, Biology, Electronics and Technical Vocational subject Obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together. A. Passed Diploma examination from an AICTE approved Institution with at least 45% marks (40% in case of candidates belonging to SC/ST category) in appropriate branch of Engineering / Technology. B. Passed B. Sc Degree from a recognized University as defined by UGC, with at least 45% marks (40% in case of candidates belonging to SC/ST category) and passed XII standard with mathematics as a subject. C. Provided that in case of students belonging to B. Sc. Stream, shall clear the subjects of Engineering Graphics / Engineering Drawing and Engineering Mechanics of the first year Engineering program along with the second year subjects. D. Provided further that, the students belonging to B. Sc. Stream shall be considered only after filling the seats in this category with students belonging to the Diploma stream. E. Provided further that student, who have passed Diploma in Engineering & Technology from an AICTE approved Institution or B. Sc., Degree from a recognized University as defined by UGC, shall also be eligible for admission to the first year Engineering Degree courses subject to vacancies in the first year class in case the vacancies at lateral entry are exhausted. However the admissions shall be based strictly on the eligibility criteria as mentioned in A, B, D, and E above. Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective	
	Bachelor of Technology (B Tech)	Lateral entry to fourth year	Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective	

I SI NO	D	1		.			
31. 110.	Program	Durati	on Eligibil	ty	ad branch of	study provided	
		ye	ar) he	she fulfils the Univers	ity requireme	nts.	
4	B. Tech.	in	Pass i	n PUC / 10+2 exan	nination wit	n Physics and	
	Bioelec	troni	Ma	thematics as compuls	ory subjects	along with one	
Sl. No. Program Duration Eligibility (final year) Semester in the concerned branch of study, provided he/she fulfils the University requirements. 4 B. Tech. in Bioelectroni Cs Pass in PUC / 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry / Biotechnology / Biology / Computer Science / Electronics / Technical Vocational subjects and obtained minimum 45% marks (40% in case of candidates belonging to SC / ST category) in the above subjects taken together of any board recognized by the respective State Government / Central Government / Union Territories or any other qualification recognized as equivalent there to. 5.2 Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies such as AICTE, UGC from time to time. 6. Courses of Study and Credits 6.1 Each course of study is assigned with certain credit value 6.2 Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for final examination, evaluation and announcement of results 6.3 The credit hours defined as below: In terms of credits, every one hour session of L amounts to 1 credit per Semester and minimum of two hour session of T or P amounts to 1 credit per Semester or a three hou session of T / P amounts to 2 credits over a period of one Semester of 16 weeks for teaching learning process.							
			Sci	ence / Electronics / T	echnical Voca	ntional subjects	
			an	d obtained minimum	45% marks (40% in case of	
			Cal	niects taken together	of any hoard	recognized by	
			the	respective State	Governme	nt / Central	
			Go	vernment / Union	Territories	or any other	
			qù	alification recognized a	s equivalent	there to.	
5.2 Provi	ded further th	at the eligibilit	y criteria are sub	ject to revision by the	Government	Statutory Bodies	
such a	is AICTE, UGC	from time to tir	ne.				
6. Cours	es of Study an	d Credits					
200.0							
	6.1 Each co	ourse of study	s assigned with c	ertain credit value			
	6.2 Each se	emester is for a	total duration of	20 weeks out of which	16 weeks ded	icated for teachin	
	and lea	arning and the r	emaining 4 week	s for final examination	, evaluation a	nd announcemen	
	of resu	alits adit hours dofin	od as bolow:				
	In tern	ns of credits. e	very one hour s	ession of L amounts t	o 1 credit pe	er Semester and	
	minim	um of two hou	r session of T or	P amounts to 1 credit	t per Semest	er or a three hou	
	sessior	of T / P amou	nts to 2 credits o	er a period of one Sen	nester of 16 v	eeks for teaching	
	learnin	g process.	\wedge				
	1 creal	t = 13 credit no emester is 20 v	urs spread over 1	6 weeks or spread ove	r the semeste	er	
The total o				Seniester-ena examin			
The total o The follow	ing table desc	ribes credit pat	ern		14110111		
The total of The follow	ing table desc	ribes credit pat	tern	Credit Pattern			
The total o	ing table desc	ribes credit pat	Table -2:	Credit Pattern	Total	Total Contact	
The total of The follow	ing table desc	Tutorials (T)	Table -2:	Credit Pattern Credits (L:T:P)	Total Credits	Total Contact Hours	
The total of The follow	Lectures (L)	Tutorials (T)	Table -2: Practice (P)	Credit Pattern Credits (L:T:P) 4:1:0	Total Credits 5	Total Contact Hours 6	
The total of The follow	Lectures (L)	Tutorials (T)	Table -2: Practice (P) 0 0	Credit Pattern Credits (L:T:P) 4:1:0 3:1:0	Total Credits 5 4	Total Contact Hours 6 5	
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Table -2: Credit Pattern								
Lectures (L)	Tutorials (T)	Practice (P)	Credits (L:T:P)	Total Credits	Total Contact Hours			
4	2	0	4:1:0	5	6			
3	2	0	3:1:0	4	5			
3	0	2	3:0:1	4	5			
2	2	2	2:1:1	4	6			
0	0	6	0:0:3	3	6			
4	0	0	4:0:0	4	4			

7. Different Courses of Study:

Different Courses of Study are labeled as follows:

- a. Core Course (CC)
- b. Foundation Course (FC)
- c. Hard Core Course (HC)
- d. Soft Core Course (SC)
- e. Open Elective Course (OE)
- f. Project Work / Dissertation:
- g. A project work carrying TWO, FOUR or SIX credits is called Minor Project work / Dissertation. A project work of EIGHT, TEN, TWELVE or SIXTEEN credits is called Major Project work / Dissertation. A Project work may be a hard core or a Soft Core as decided by the BoS / concerned.

These are defined under Section 4 of these regulations.

8. Credits and Credit Distribution

8.1 A candidate has to earn 160 credits for successful completion of B Tech degree with the distribution of credits for different courses as given in table below:

	Credits (Range)
Course Type	For B Tech Degree (8 Semesters)
Foundation Core Course	A minimum of 06 but not exceeding 12
Hard Core Course	A minimum of 118 but not exceeding 121
Soft Core Course	A minimum of 15 but not exceeding 21
Open Elective	A minimum of 04 but not exceeding 12

- **8.2.** The concerned BOS based on the credits distribution pattern given above shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective, as **Foundation Course (FC)**, **Hard Core (HC) or Soft Core (SC)**, **Open Elective (OE)**.
- **8.3.** Every course including project work, practical work, field work, self-study elective should be entitled as Foundation Course (FC), Hard Core (HC) or Soft Core (SC) or Open Elective (OE) or Core Course (CC) by the BoS concerned. However, following shall be the Foundation Courses with credits mentioned against them, common to all branches of study.

SI.	Course Title	Number of					
No.		Credits					
Foundat	Foundation Courses						
1	English for Technical Communication /	2-3					
	Communicative Skills						
2	Environmental Studies / Environmental Sciences	2					
3	Indian Constitution and Professional Ethics	2					
4	MOOC / Internship /Soft Skill Training	6-15					

- 8.4. The concerned 80S shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program.

 8.5. A candidate can enrol for a maximum of 28 credits and a minimum of 19 credits per Semester. However he / she may not successfully searn a maximum of 28 credits per semester. This maximum of 28 credits does not include the credits of courses cardidates.

 8.6. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully 180 credits in 8 successive semesters shall be considered for declaration of Ranks, Medis, Prizes and are eligible to apply for Student Fellowship, Schlarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

 8.7. Add- on Proficiency Certification:

 10 acquire Add on Proficiency Certification:

 10 acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:

 10 acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:

 10 acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:

 10 acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:

 10 acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:

 10 acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:

 10 acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:

 10 acquire Add on Proficiency Certification in the same discipline/ subject or in different discipline/ but the same discipline/ subject or in different discipline/ but the same discipline/ subject or in different discipline/ but the same discipline/ subject or in different discipline/ but the same discipline/ subject or in different discipline/ but the same discipline/ subject or in different discipline/ but the same discipline/ subject or in different discipline/ but the same discipline/ subject or in different discipline/ but the same discipline/ subject o

Internal Test	30 marks
Assignments / Seminars / Model Making / Integrated Lab /	20 marks
Project Based Learning / Quizzes etc.	

- 9.6 There shall be one Assignment / Project Based Learning / Field Visit / Quiz test carrying 20 marks covering the last 20% of the Syllabus
 9.7 The Semester End Examination for 50 marks shall be held in the 18° and 19° week of the beginning of the semester and the syllabus of the semester and examination shall be entire syllabus
 9.8 A test paper is set for a maximum of 30 marks to be answered in 1 hour duration. A test paper can have 4 main guestion. Each main question are into 10 marks. The main questions. A test paper can have 4 main questions all totalling 10 marks. Students are required to answer any three main questions. Each question is set using fillomor's verb. The questions must be set to asset he course outcome described in the course document even with the choice is given in question.
 9.5 The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question appears for internal test shall be set by the internal teachers who have taught the course and set the test paper.

 9.11 Pasignment/Semina/Project based learning/simulation based problem solving/field work should be set in such a way, students be able to apply the concepts learn to a real life situation and students should be able to do some amount self study and restrict thinking. While setting assignment care should be taken such that the students will not be able to plaggiarise the answer from web or any other resources. An assignment / Quick can be set for a maximum of 20 course instructor at higher discretion can design the questions as a small group exercise or individual exercise. This should encourage collopatories learning and team learning and also self-study.

 9.12 Internal assessment marks must be decide

course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. The Examination Review Committee shall also review the question papers of both Internal Tests as well Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.

- **9.19**The report provided by the Examination Review Committee shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program
- **9.20**During unforeseen situation like the Covid-19, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC
- **9.21**University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper
- **9.22**Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor
- **9.23**Online courses may be offered as per UGC norms.

For online course assessment guidelines would be as follows:

- 1. If the assessment is done by the course provider, then the School can accept the marks awarded by the course provider and assign the grade as per REVA University norms.
- 2. If the assessment is not done by the course provider then the assessment is organized by the concerned school and the procedure explained in the regulation will apply
- 3. In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

IAs for online courses could be avoided and will remain at the discretion of the School.

9.24The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

- 9.25Utilization of one or two credit online courses would be:
 - 4 week online course 1 credit

- 8 week online course / MOOC 2 credits
- 12 week online course / MOOC 3 credits
- **9.26Summary of Internal Assessment, Semester End Examination and Evaluation** Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

SI.	Type of	when	Syllabus	Max	Reduced	Date by	
No.	Assessment		Covered	Marks	to	which the	
						process must	
						be completed	
1	During 6 th		First 40%	30	15	7 th week	
_	rest-1	week	First 40%	30	13	/ week	
2	Test -2	During 12 th	Second 40%	30	15	13 th Week	
	1651-2	Week	Second 40%	30	15	13 Week	
3	Assignment /	15 th Week	Last 20%	20	20	16 th Week	
3	Quiz	Quiz 15 week		20	20	To, Meek	
4	SEE	18/19 th Week	100%	100	50	20 th Week	

10 Assessment of Students Performance in Practical Courses

The performance in the practice tasks / experiments shall be assessed on the basis of:

- a) Knowledge of relevant processes;
- b) Skills and operations involved;
- c) Results / products including calculation and reporting.

	ШШШ			11111111111111111				
10.3	1 т	he 50 marks meant for Internal Assessment (IA) of the performa	nco in car	rrying out n	vractical chall			
_			ince in car	rrying out p	oractical Stiall			
Ture	further be allocated as under:							
i		Conduction of regular practical / experiments throughout the ser	mester	20 marks				
ii	1	Maintenance of lab records		10 marks				
iii	i 1	Performance of mid-term test (to be conducted while cond	ducting	20 marks				
		second test for theory courses); the performance assessme						
		the mid-term test includes performance in the conduct	tion of					
<u> </u>	-	experiment and write up about the experiment.		FO montes				
		Total Total		50 marks				
10.2 T	he 50 r	narks meant for Semester End Examination (SEE), shall be alloca	ated as ur	nder:				
	i	Conducting of semester end practical examination		30 mar	rks			
	ii	Write up about the experiment / practical conducted		10 mar	rks			
	iii	Viva Voce		10 mar	rks			
		Total		50 mai	rks			
For > 3 c	redit c	ourses			_			
	i	IA-I	25 mark	.s				
		IA-2	/ \ .	_	1			
	ii		25 mark	is \				
	iii	Semester end examination by the concern school board	25 mark 50 mark					
	-	Semester end examination by the concern school board (demo, test, viva voice etc.)	50 mark	S				
	-	Semester end examination by the concern school board		S				
For 1 & 2	iii	Semester end examination by the concern school board (demo, test, viva voice etc.)	50 mark	S				
For 1 & :	iii	Semester end examination by the concern school board (demo, test, viva voice etc.) Total	50 mark	S				
For 1 & :	iii	Semester end examination by the concern school board (demo, test, viva voice etc.) Total t courses IA Semester end examination by the concern school board (den	50 mark	rks				
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For 1 & :	iii 2 credi	Semester end examination by the concern school board (demo, test, viva voice etc.) Total t courses IA Semester end examination by the concern school board (den	100 mark 100 mar 25 i	rks marks				
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	iii 2 credii iiii	Semester end examination by the concern school board (demo, test, viva voice etc.) Total t courses IA Semester end examination by the concern school board (den test, viva voice etc.)	100 mark 100 mar 25 i	rks marks marks				
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i	Conducting of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	50 marks

i	IA-I	25 marks
ii	IA-2	25 marks
iii	Semester end examination by the concern school board	50 marks
	(demo, test, viva voice etc.)	
	Total	100 marks

i	IA	25 marks
iii	Semester end examination by the concern school board (demo,	25 marks
	test, viva voice etc.)	
	Total	50 marks

Component – I	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (50%)

Marks,	Grade,	Grade Point	Letter
Р	G	(GP=V x G)	Grade
90-100	10	v*10	0
80-89	9	v*9	A+
70-79	8	v*8	А
60-69	7	v*7	B+
55-59	6	v*6	В
50-54	5.5	v*5.5	C+
40-49	5	v*5	С
0-39	0	v*0	F
	ABSEN	Т	AB

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	in the course	However a condi	data has to socure s	minimum of 20	0/ /12 marks) in Competon	r Fod
	In the course.	However, a candi F) which is compuls	date has to secure a	a minimum of 25	% (13 marks) in Semester	r Ena
	The Grade and t	he Grade Point: Th	ory. e Grade and the Grad	e Point earned by	the candidate in the subject	ct will
	be as given belo	w:		,		
		Marks,	Grade,	Grade Point	Letter	
		Р	G	(GP=V x G)	Grade	
		90-100	10	v*10	0	
		80-89	9	v*9	A+	
		70-79	8	v*8	А	
		60-69	7	v*7	B+	
		55-59	6	v*6	В	
		50-54	5.5	v*5.5	C+	
		40-49	5	v*5	C	
		0-39	0	v*0	F	
			ABSENT		AB	
The	SGPA is the ratio	of sum of the proc	e Semester Grade Pol	int Average (SGPA credits with the	n). Grade noints scored by a stu	ıdent
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The in all stud and Illus	SGPA is the rational stration No. 1	of sum of the process of the sum	e semester Grade Polluct of the number of the sum of the number of the number of the number of the sum of the number of the sum of	int Average (SGPA) credits with the mber of credits of where Ci.is the numbers.	grade points scored by a stuff all the courses undergone imber of credits of the ith co	udent by a ourse
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C	Consulta	Consider latters	Condo Daint	Credit Point (Credit x
Course	Credit	Grade letter	Grade Point	Grade point)

Course 1	4	А	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	В	6	3X6=18
Course 6	3	С	5	3X5=15
Course 7	2	B+	7	2X7=21
Course 8	2	0	10	2X10=20
	24			175

	Course 1	4	Α	8	4X8=32
	Course 2	4	B+	7	4X7=28
	Course 3	3	A+	9	3X9=27
	Course 4	3	B+	7	3X7=21
	Course 5	3	В	6	3X6=18
	Course 6	3	С	5	3X5=15
	Course 7	2	B+	7	2X7=21
	Course 8	2	0	10	2X10=20
		24			175
Thu Illu s	s, SGPA = 175 ÷ 2 tration No.3	4 = 7.29	Grade Letter	Grade Point	4X8=32 4X7=28 3X9=27 3X7=21 3X6=18 3X5=15 2X7=21 2X10=20 175 Credit Point (Credit x Grade point) 4 x 10 = 40 4 x 9 = 36 3 x 7 = 21 3 x 6 = 18 3 x 9 = 27 3 x 7 = 21 2 x 9 = 18 2 x 9 = 18 199
	Course	Cicuit	Grade Ectter	> Grade Fount	(Credit x Grade point)
	Course 1	4	0	10	4 x 10 = 40
	Course 2	4	A+ /	9	4 x 9 = 36
	Course 3	$\frac{3}{2}$	B+ /	7	$3 \times 7 = 21$
	Course 4	3	B	6	3 X 6 = 18
	Course 5	3	A+	9	3 X 9 = 27
	Course 7	3	Δ+	9	2 v Q = 18
	Course 8	2	Δ+	9	2 x 9 = 18
	Course o	24			199
b.	Cumulative Grad Overall Cumulativ number of credits	e Point Average (/e Grade Point Average (s (160) for B. Tech rgone by a studer	(CGPA): verage (CGPA) of a can n degree in Engineering nt over all the semeste nester and Ci is the to	ndidate after succ g & Technology is ers of a program, tal number of cre	eessful completion of the requestion of the req
Illus	the courses unde Where Si is the So tration:				
Illus CGF	the courses unde Where Si is the So tration: A after Final Sem	ester			
Illu: CGF	the courses unde Where Si is the So tration: A after Final Sem Semester	ester No. of	f Credits S	GPA	Credits x SGPA
Illus CGF	where Si is the So tration: A after Final Sem Semester (ith)	ester No. of	f Credits S	GPA (Si)	Credits x SGPA (Ci X Si)
Illu: CGF	Where Si is the Soutration: A after Final Sem Semester (ith) 1	ester No. of	f Credits S (Ci)	GPA (Si) 5.83 19	Credits x SGPA (Ci X Si) x 6.83 = 129.77
Illus CGF	where Si is the Soutration: A after Final Sem Semester (ith) 1	ester No. of	f Credits S (Ci) 19 6 21 7	GPA (Si) 5.83 19 7.29 21	Credits x SGPA (Ci X Si) x 6.83 = 129.77 x 7.29 = 153.09
Illus CGF	Where Si is the Soutration: A after Final Sem Semester (ith) 1 2 3	ester No. of	f Credits (Ci) 19 6 21 7 22 8	GPA (Si) 5.83 19 7.29 21 3.11 22	Credits x SGPA (Ci X Si) x 6.83 = 129.77 x 7.29 = 153.09 x 8.11 = 178.42
Illus CGF	the courses unde Where Si is the So tration: A after Final Sem Semester (ith) 1 2 3 4	ester No. of	f Credits (Ci) 19 6 21 22 8 22 2 2 2 2 2 2 2 2 2 2 2 2 2 2	GPA (Si) 5.83 19 7.29 21 3.11 22 7.40 22	Credits x SGPA (Ci X Si) x 6.83 = 129.77 x 7.29 = 153.09 x 8.11 = 178.42 x 7.40 = 162.80
Illus CGF	Where Si is the Soutration: A after Final Sem Semester (ith) 1 2 3 4 5	ester No. of	f Credits (Ci) 19 6 21 7 22 8 22 8	GPA (Si) 5.83 19 7.29 21 3.11 22 7.40 22 3.29 22	Credits x SGPA (Ci X Si) x 6.83 = 129.77 x 7.29 = 153.09 x 8.11 = 178.42 x 7.40 = 162.80 x 8.29 = 182.38
Illus CGF	the courses unde Where Si is the So tration: A after Final Sem Semester (ith) 1 2 3 4 5 6	ester No. of	f Credits (Ci) 19 6 21 7 22 8 22 8 22 8 22 8 22 8 22 8 22 8	GPA (Si) 5.83 19 7.29 21 3.11 22 7.40 22 3.29 22 3.58 22	Credits x SGPA (Ci X Si) x 6.83 = 129.77 x 7.29 = 153.09 x 8.11 = 178.42 x 7.40 = 162.80 x 8.29 = 182.38 x 8.58 = 188.76
Illus CGF	the courses unde Where Si is the So tration: A after Final Sem Semester (ith) 1 2 3 4 5 6 7	ester No. of	f Credits (Ci) 19 6 21 7 22 8 22 8 22 8 22 8 21 9	GPA (Si) 5.83 19 7.29 21 3.11 22 7.40 22 3.29 22 3.58 22 9.12 22	Credits x SGPA (Ci X Si) x 6.83 = 129.77 x 7.29 = 153.09 x 8.11 = 178.42 x 7.40 = 162.80 x 8.29 = 182.38 x 8.58 = 188.76 x 9.12 = 200.64 x 9.25 = 92.50
Illus	the courses unde Where Si is the So tration: A after Final Sem Semester (ith) 1 2 3 4 5 6 7 8 Cumulative	ester No. of	f Credits (Ci) 19 6 21 7 22 8 22 8 22 8 22 8 21 9 10 9 160	GPA (Si) 5.83 19 7.29 21 3.11 22 7.40 22 3.58 22 9.12 22 9.25 10	4X8=32

Semester	No. of Credits	SGPA	Credits x SGPA
(ith)	(Ci)	(Si)	(Ci X Si)
1	19	6.83	19 x 6.83 = 129.77
2	21	7.29	21 x 7.29 = 153.09
3	22	8.11	22 x 8.11 = 178.42
4	22	7.40	22 x 7.40 = 162.80
5	22	8.29	22 x 8.29 = 182.38
6	22	8.58	22 x 8.58 = 188.76
7	22	9.12	22 x 9.12 = 200.64
8	10	9.25	10 x 9.25 =92.50
Cumulative	160		1288.36

Thus, **CGPA** = 19x6.83+21x7.29+22x8.11+22x7.40+22x8.29+22x8.58+22x9.12+10x9.25 = 8.05

160

c. Conversion of grades into percentage:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.05 x 10=80.5

d. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

13. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Grade (Numerical Index)	Letter Grade	Performance	FGP
	G		\wedge	Qualitative Index
9 >= CGPA 10	10	0/	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	Distiliction
7 >= CGPA < 8	8	Α/	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	FIISt Class
5.5> = CGPA < 6		В	Above	\wedge
	6		average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5		Satisfactory	Pass
< 4 CGPA	/_0 /	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

a. Provisional Grade Card: The tentative / provisional grade card will be issued by the Controller of Examinations at the end of every semester indicating the courses completed successfully. The provisional grade card provides Semester Grade Point Average (SGPA).

b. Final Grade Card: Upon successful completion of B Tech Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14. Attendance Requirement:

- **14.1** All students must attend every lecture, tutorial and practical classes.
- **14.2** In case a student is on approved leave of absence (e.g.- representing the University in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.
- **14.3** Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester examination and such student shall seek re-admission

15. Re-Registration and Re-Admission:

15.1 In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for semester end examination and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

15.2. In such case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

16. Absence during Internal Test:

17. In case a student has been absent from an internal tests due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the ment of the case and after consultation with course instruction and class teacher, and arrange to conduct a special ment after as for such candidately well in advance before the Semester End Esamination of that respective semester. Under no circumstances internal tests shall be held? assignment are excepted after Semester as excepted after Semester in Esamination.

17. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Internal Tests and Assignments), angle-face ana approach the Ginevance Cell with the written submission together with all facts, the assignments, and test papers, which were evaluated. Helybe can do so before the commencement of respective semester—end examination. The Ginevance Cell with the university on the candidate if list/her submission is found to be baseless and unduly morbitate. This camps recommend for taking disciplinary/corrective action on an evaluator if helybe is found guilty. The decision taken by the Ginevance committee is as follows:

18. Grievance Committee:

19. Cardidate is of Students shall appear the submission is found to be baseless and unduly morbitate. This camps recommend for taking disciplinary/corrective action on an evaluator if helybe is found guilty. The decision taken by the Ginevance committee is as follows:

19. The Controller of Examinations are possible t

- esamination of failed courses of previous semesters concurrently with odd semester and examinations and

 / or even semester end examinations of current year of study.

 Case 1: A student who has failed in a maximum of 4 courses in 1º and 2º semester together shall move to the
 3º semester of the succeeding year.

 Case 2: A students who has failed in a maximum of 4 courses from semester 1 to 4 together shall move to the 5º semester of the succeeding year.

 Case 3: A students who has failed in a maximum of 4 courses from semester 1 to 6 together shall move to the
 7º semester of the succeeding year.

 22. Challenge Valuation:

 a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script(s) of semester end warmination by paying, the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade avarried to him/her by surrendering the grade avarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Controller of Examinations. Within 10 days after the announcement of the results. This challenge valuation is only for semester end examination.

 b. The answer scripts (in whatever form) for which challenge valuation is sought for shall be exclused by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation is any specific case of ambiguity and unsolved problem; the decision of the Vice-Chancellor shall be final.

 23. With regard to any specific case of ambiguity and unsolved problem; the decision of the Vice-Chancellor shall be final.

 24. All assessments must be done by the respective Schools as per the guidelines issued by the Controller of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students less with the office of the Controller of Examinations. However, the responsibility of announcing final examination results and issuing

Course No Code Title of the Course HC/FC/SC/ OE Pre requisite Credit Value Hours / Week	Si. Course Code Title of the Course HC/FC/SC/OE Pre requisite Credit Value Hours / Week	Si. Course No Code Title of the Course HC/FC/SC/ OE Pre requisite L T P Total Hours / Week	Sil	Si. Course No Code Title of the Course HC/FC/SC/ OE Pre requisite Credit Value Hours / Week	SI. Course No Code Title of the Course HC/FC/SC/OE Pre requisite Credit Value Hours / Week	SI. Course No Code Title of the Course HC/FC/SC/OE Pre requisite Credit Valuer Mours / Week	SI. Course No Code Title of the Course HC/FC/SC/ OE Pre quisite Credit Value Hours / Week	SCHOOL OF MECHANICAL Engineering Program SCHMSTRICTURE for B. Tech Mechanical Engineering Program Title of the Course HC/FC/SC/ Pre requisite L T P Total Hours / Week	SI. Course No Code	se			cle-1)		- دالي		^		
No Code Title of the Course OE requisite Code Code Title of the Course OE requisite Code C	No Code	No Code	No	No Code	No	No	No Code	No Code	No Code			HC/FC/SC/	Pre	Cro	edit P	atte	rn &	С	Contact
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B20ER0201 Elements of Mechanical Engineering HC - 3 0 1 4 5 Practical /Term Work / Practice Sessions/Online /MOOC 6 B20AS0109 Biology for Engineers FC - 1 0 0 1 1 7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25	Practical / Term Work / Practice Sessions/Online / MOOC 6 B20AS0109 Biology for Engineers FC - 1 0 0 1 1 7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25	7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25	7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25	TOTAL 16 0 5 21 25		TOTAL SEMESTER CREDITS 21		TOTAL CUMULATIVE CREDITS 40	SI. Course No Code 1 B20AS02 2 B20AS02 3 B20CI01 4 B20EE01 5 B20ER02 6 B20AS01 7 B20ME01	205 205 201 101 201 201 201 201 201 201 201 201	Vector Calculus and Partial Differential Equations Applied Chemistry Introduction to Python programming Basic Electrical and Electronics Engineering Elements of Mechanical Engineering Practical /Term V Biology for Engineers Design Thinking	FC HC	Pre requisite B20AS0103 - e Sessions/On TOTAL TOTAL TOTAL	3 3 3 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	CRED CRED CRED Credii	t Padit \	ttern 8 /alue P To 0 1 1 1 5 2	19 19 23 ttal 4 3 3 4 4	Contact Hours/ Week 4 3 4 5 1 3 25
Elements of Mechanical Engineering HC - 3 0 1 4 5 Practical /Term Work / Practice Sessions/Online /MOOC 6 B20AS0109 Biology for Engineers FC - 1 0 0 1 1 7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25	Practical / Term Work / Practice Sessions/Online / MOOC 6 B20AS0109 Biology for Engineers FC - 1 0 0 1 1 7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25 TOTAL SEMESTER CREDITS 21	7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25 TOTAL SEMESTER CREDITS 21	7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25 TOTAL SEMESTER CREDITS 21	TOTAL 16 0 5 21 25 TOTAL SEMESTER CREDITS 21	TOTAL SEMESTER CREDITS 21		TOTAL CUMULATIVE CREDITS 40	TOTAL CONTACT HOURS	SI. Course No Code 1 B20AS02 2 B20AS02 3 B20CI01 4 B20EE01 5 B20ER02 6 B20AS01 7 B20ME01	se e e 0205 0201 101 0201 0109 0102	Vector Calculus and Partial Differential Equations Applied Chemistry Introduction to Python programming Basic Electrical and Electronics Engineering Elements of Mechanical Engineering Practical /Term V Biology for Engineers Design Thinking	FC HC HC HC HC HC HC HC HC	TOTAL SEMES TAL CUMULAT TOTAL CON Cle-2) Pre requisite B20AS0103 E Sessions/On - TOTAL TOTAL SEN	TACT L L 3 3 3 1 1 1 MEST	CRED CRED CRED HOL Credi 1 1 (((((((((((((((((t Paadit \	ttern 8 /alue P To 0	19 19 23 (tal) 4 3 3 4 4 1 2 2 2	Contact Hours/ Week 4 3 4 5 1 3 25
Section Figure	Practical / Term Work / Practice Sessions/Online / MOOC 6 B20AS0109 Biology for Engineers FC - 1 0 0 1 1 7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25 TOTAL SEMESTER CREDITS 21 TOTAL CUMULATIVE CREDITS 40	7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL 16 0 5 21 25 TOTAL SEMESTER CREDITS 21 TOTAL CUMULATIVE CREDITS 40	7 B20ME0102 Design Thinking HC - 1 0 1 2 3 TOTAL SEMESTER CREDITS 21 25 TOTAL CUMULATIVE CREDITS 21 TOTAL CUMULATIVE CREDITS 40	TOTAL 16 0 5 21 25 TOTAL SEMESTER CREDITS 21 TOTAL CUMULATIVE CREDITS 40	TOTAL SEMESTER CREDITS 21 TOTAL CUMULATIVE CREDITS 40	TOTAL CUMULATIVE CREDITS 40		TOTAL CONTACT HOURS 25	SI. Course No Code 1 B20AS02 2 B20AS02 3 B20CI010 4 B20EE01 5 B20ER02 6 B20AS01 7 B20ME01	205 201 101 201 201 201 201 201 201 201 201	Vector Calculus and Partial Differential Equations Applied Chemistry Introduction to Python programming Basic Electrical and Electronics Engineering Elements of Mechanical Engineering Practical /Term V Biology for Engineers Design Thinking	FC HC HC HC HC HC HC HC HC HC	TOTAL SEMES TAL CUMULAT TOTAL CON Cle-2) Pre requisite B20AS0103 E Sessions/On - TOTAL TOTAL SEM TOTAL CUMU	TACT L 3 3 3 1 1 1 1 L MEST	CRED CRED CRED HOL Credii Cr	t Paddit \	ttern 8 /alue P To 0 1 1 1 5 2 TS	19 19 23 ttal 4 3 3 4 4 1 2 2 2 4	Contact Hours/ Week 4 3 4 5 1 3 25

SI. No	Course Code	Title of the Course	HC/FC/SC/ OE	Pre requisite		edit F Credi			Contact Hours/
INO	Code		OE \	requisite	L	T	Р	Total	Week
1	B20AS0205	Vector Calculus and Partial Differential Equations	FC	B20AS0103	3	1	0	4	4
2	B20AS0201	Applied Chemistry	/ FC	_	3	0	0	3	3
3	B20Cl0101	Introduction to Python programming	HC	_	2	0	1	3	4
4	B20EE0101	Basic Electrical and Electronics Engineering	НС	-	3	0	1	4	5
5	B20ER0201	Elements of Mechanical Engineering	НС	-	3	0	1	4	5
		Practical /Term W	ork / Practice	Sessions/Onli	ne /N	100C			
6	B20AS0109	Biology for Engineers	FC	-	1	0	0	1	1
7	B20ME0102	Design Thinking	НС	-	1	0	1	2	3
				TOTAL	16	0	5	21	25
				TOTAL SEM	ESTER	CREE	OITS		21
				TOTAL CUMUL	ATIVE	CREE	DITS		40
				TOTAL CO	NTAC	ТНО	JRS		25

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SI. Course No Code	Title of the Course	HC/FC/	Pre	Credit Pattern & Credit Value				Contact Hours/
Code		50	requisite	L	T	Р	Total	Week
B20AS0304	Laplace Transforms and Fourier Series	FC	B20AS0205	3	0	0	3	3
B20ER0301	Engineering Thermodynamics	НС		3	1	0	4	4
B20ER0302	Material Science	HC		3	0	0	3	3
B20ER0303	Manufacturing Science	НС		3	0	1	4	5
B20ER0304	Mechanics of Materials	НС		3	0	1	4	5
	Practical /Term Wo	rk / Pract	ice Sessions/O	nline /	/M00	С		
B20AH0301	Communication Skill	FC		2	0	0	2	2
B20LS0301	Indian constitution and Professional Ethics	FC		2	0	0	2	2
B20AHM301	Advanced Kannada	MC		0	0	0	0	2
B20AHM302	Basics of Kannada	MC		0	0	0	0	2
		$\overline{}$	TOTAL	19	1	2	22	28
			TOTAL SEN	NESTE	R CREE	OITS	22	
			TOTAL CUMU	LATIV	E CRED	OITS		62
			TOTALC	ONTA	ст но	URS		26
	Code B20AS0304 B20ER0301 B20ER0302 B20ER0303 B20ER0304 B20AH0301 B20AHM301	Course Code B20AS0304 B20ER0301 B20ER0302 B20ER0302 B20ER0303 B20ER0304 B20ER0304 B20ER0304 B20ER0304 B20ER0304 B20ER0304 B20AH0301 B20LS0301 B20LS0301 B20AHM301 Advanced Kannada	Course CodeTitle of the CourseHC/FC/SC/OEB20AS0304Laplace Transforms and Fourier SeriesFCB20ER0301Engineering ThermodynamicsHCB20ER0302Material ScienceHCB20ER0303Manufacturing ScienceHCB20ER0304Mechanics of MaterialsHCPractical /Term Work / PractB20AH0301Communication Skill Indian constitution and Professional EthicsFCB20AHM301Advanced KannadaMC	Code B20AS0304 Laplace Transforms and Fourier Series Engineering Thermodynamics B20ER0302 Material Science B20ER0304 Mechanics of Materials Practical /Term Work / Practice Sessions/O B20AH0301 Communication Skill B20AH0301 Advanced Kannada B20AHM301 B20AHM302 Basics of Kannada FC FC FC FC FC FC FC FC FC F	Course CodeTitle of the CourseHC/FC/SC/OEPre requisiteCred LB20AS0304Laplace Transforms and Fourier SeriesFCB20AS02053B20ER0301Engineering ThermodynamicsHC3B20ER0302Material ScienceHC3B20ER0303Manufacturing ScienceHC3B20ER0304Mechanics of MaterialsHC3Practical /Term Work / Practice Sessions/Online / B20AH0301B20AH0301Communication Skill EthicsFC2B20AHM301Advanced Kannada EthicsFC2B20AHM302Basics of KannadaMC0TOTAL19TOTAL SEMESTE TOTAL CUMULATIV	Course CodeTitle of the CourseHC/FC/SC/OEPre requisiteCredit Patt VolumeB20AS0304Laplace Transforms and Fourier SeriesFCB20AS020530B20ER0301Engineering ThermodynamicsHC31B20ER0302Material ScienceHC30B20ER0303Manufacturing ScienceHC30B20ER0304Mechanics of MaterialsHC30Practical /Term Work / Practice Sessions/Online /MOORD B20AH0301B20AH0301Communication SkillFC20B20AH0301Indian constitution and Professional EthicsFC20B20AHM301Advanced KannadaMC00B20AHM302Basics of KannadaMC00B20AHM302Basics of KannadaMC00TOTAL 191TOTAL SEMESTER CREETOTAL CUMULATIVE CREE	Course Code Title of the Course HC/FC/SC/OE Pre requisite Credit Pattern & Value B20AS0304 Laplace Transforms and Fourier Series FC B20AS0205 3 0 0 B20ER0301 Engineering Thermodynamics HC 3 1 0 B20ER0302 Material Science HC 3 0 1 B20ER0303 Manufacturing Science HC 3 0 1 B20ER0304 Mechanics Of Materials HC 3 0 1 B20AH0301 Communication Skill FC 2 0 0 B20LS0301 Indian constitution and Professional Ethics FC 2 0 0 B20AHM301 Advanced Kannada MC 0 0 0 0 B20AHM302 Basics of Kannada MC 0 0 0 0	Course Code Title of the Course HC/FC/SC/OE Pre requisite Credit Pattern & Credit Value B20AS0304 Laplace Transforms and Fourier Series FC B20AS0205 3 0 0 3 B20ER0301 Engineering Thermodynamics HC 3 1 0 4 B20ER0302 Material Science HC 3 0 0 3 B20ER0303 Manufacturing Science HC 3 0 1 4 B20ER0304 Mechanics of Materials HC 3 0 1 4 Practical /Term Work / Practice Sessions/Online /MOOC B20AH0301 Communication Skill FC 2 0 0 2 B20LS0301 Indian constitution and Professional Ethics FC 2 0 0 2 B20AHM301 Advanced Kannada MC 0 0 0 0 B20AHM302 Basics of Kannada MC 0 0 0 0 TOTAL SEMESTER CREDITS

1 B20AS0304 2 B20ER0301 3 B20ER0302 4 B20ER0303	Laplace Transforms and Fourier Series Engineering Thermodynamics	FC B			١	/alue	& Credit Total		Contact Hours/
1 B20AS0304 2 B20ER0301 3 B20ER0302 4 B20ER0303	and Fourier Series Engineering Thermodynamics	FC I B	requisite	L	T	P	To	otal	Week
B20ER0301B20ER0302B20ER0303	Thermodynamics	-	320AS0205	3	0	0		3	3
3 B20ER0302 4 B20ER0303	Natorial Calaras	НС		3	1	0		4	4
4 B20ER0303	Manufacturing	HC		3	0	0		3	3
	Science	НС		3	0	1		4	5
5 B20ER0304	Materials of	НС		3	0	1		4	5
C D204110204	Practical /Term Wor	rk / Practice	Sessions/O	nline ,	/MOC	C		2	
6 B20AH0301	Indian constitution	FC		2	0	0		2	2
7 B20LS0301	and Professional	FC		2	0	0		2	2
8 B20AHM301	. Advanced Kannada	МС		0	0	0		0	2
B20AHM302	Basics of Kannada	MC	TÔTAL	0	0	0		0	2
			TOTAL SEA	19 VESTE	R CRE	DITS	-	22	28
			OTAL CUMU	LATIV	F CRF	DITS		6	2
			TOTALC	ONTA	CT HC	URS		2(6
	Title of the Course	HC/FC/SC/							
SI. Course	Title of the Course	HC/FC/SC	Pre		Cro	edit P Credit	atte Valu	rn &	Contact Hours/
SI. Course No Code	Title of the Course	HC/FC/SC OE	Pre requis	ite	Cro	edit P Credit	atte Valu P	rn & ue Total	Contact Hours/ Week
SI. Course Code 1 B20AS0403	Title of the Course Probability and Sampling Theory	HC/FC/SC OE	Pre requis	ite 304	Crr	edit P Credit T	atte Valu P	rn & ue Total	Contact Hours/ Week
SI. Course Code 1 B20AS0403 2 B20ER0401	Probability and Sampling Theory Mechanical Measurements and Metrology	HC/FC/SC OE FC HC	Pre requis	ite 304	Cro L 3	T 0	P 0	Total 3	Contact Hours/ Week
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402	Probability and Sampling Theory Mechanical Measurements and Metrology Machining Process	HC/FC/SC OE FC HC	Pre requis	ite 304	Cre 3 3	T 0 0	P 0 1	Total 3 3	Contact Hours/ Week 3 4
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402 4 B20ER0403	Probability and Sampling Theory Mechanical Measurements and Metrology Machining Process Kinematics and Dynamics of Machines	HC/FC/SC OE FC HC HC	Pre requis	ite 304	Cro 3 2 3 3	T 0 0 0 0	P 0 1 1 1	Total 3 3 4 4	Contact Hours/ Week 3 4 5
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402 4 B20ER0403	Probability and Sampling Theory Mechanical Measurements and Metrology Machining Process Kinematics and Dynamics of Machines Practical / Term Woi	HC/FC/SC OE FC HC HC HC CONTRACTOR CONTRACTO	B20AS0	ite 304 nline	Cro 3 3 7 MOC	O O O O O O O O O O O O O O O O O O O	P 0 1 1 1 1	Total 3 4 4	Contact Hours/ Week 3 4 5
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402 4 B20ER0403 5 B20ER0404	Probability and Sampling Theory Mechanical Measurements and Metrology Machining Process Kinematics and Dynamics of Machines Practical / Term Word Computer Aided Machine Drawing	HC/FC/SC OE FC HC HC HC HC	B20AS0 B20ME0	nline ,	Cro 2 3 3 3 /MOC 1	T 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P 0 1 1 1 2	Total 3 4 4 4 3	Contact Hours/ Week 3 4 5 5
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402 4 B20ER0403 5 B20ER0404 6 B20ER0405	Probability and Sampling Theory Mechanical Measurements and Metrology Machining Process Kinematics and Dynamics of Machines Practical /Term Wood Computer Aided Machine Drawing MATLAB for Mechanical Engineers	HC/FC/SC OE FC HC HC HC HC HC	B20AS0 B20AS0 B20ME0	nline ,	Cro 3 2 3 3 /MOC 1 0	O O O O O O O O O O O O O O O O O O O	P 0 1 1 1 1 2 1	Total 3 4 4 4 3 1	Contact Hours/ Week 3 4 5 5 2
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402 4 B20ER0403 5 B20ER0404 6 B20ER0405 7 B20MG0301	Probability and Sampling Theory Mechanical Measurements and Metrology Machining Process Kinematics and Dynamics of Machines Practical / Term Wood Computer Aided Machine Drawing MATLAB for Mechanical Engineers Management Science	HC/FC/SC OE FC HC HC HC HC HC HC	B20AS0 B20ME0	nline	Cro 1 2 3 7 7 1 0 2	0 0 0 0 0 0 0	P 0 1 1 1 1 0	Total 3 4 4 1 2	Contact Hours/ Week 3 4 5 5 2 2
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402 4 B20ER0403 5 B20ER0404 6 B20ER0405 7 B20MG0301 8 B20AS0303	Probability and Sampling Theory Mechanical Measurements and Metrology Machining Process Kinematics and Dynamics of Machines Practical /Term Word Machine Drawing MATLAB for Mechanical Engineers Management Science Environmental Science	HC/FC/SC OE FC HC	B20AS0 B20ME0	nline ,	Cro 3 2 3 3 /MOC 1 0 2 2 2	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	P 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Total 3 4 4 2 2	Contact Hours/ Week 3 4 5 5 2 2 2
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402 4 B20ER0403 5 B20ER0404 6 B20ER0405 7 B20MG0301 8 B20AS0303 9 B20AHM401	Probability and Sampling Theory Mechanical Measurements and Metrology Machining Process Kinematics and Dynamics of Machines Practical / Term Wood Computer Aided Machine Drawing MATLAB for Mechanical Engineers Management Science Environmental Science Universal Human Values	HC/FC/SC OE FC HC	B20AS0 B20ME0	nline	Cro 2 3 3 /MOC 1 0 2 2 0 16	0 0 0 0 0 0 0 0	P 0 1 1 1 1 0 0 0 6 6	Total 3 4 4 2 0 22	Contact Hours/ Week 3 4 5 5 2 2 2 30
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402 4 B20ER0403 5 B20ER0404 6 B20ER0405 7 B20MG0301 8 B20AS0303 9 B20AHM401	Probability and Sampling Theory Mechanical Measurements and Metrology Machining Process Kinematics and Dynamics of Machines Practical /Term Wood Computer Aided Machine Drawing MATLAB for Mechanical Engineers Management Science Environmental Science Universal Human Values	HC/FC/SC OE FC HC	B20AS0 B20AS0 B20MEC	nline ,	Cro 3 2 3 3 /MOC 1 0 2 2 0 16 STER	0 0 0 0 0 0 0 CRED	P 0 1 1 1 1 0 0 0 6 ITS	Total 3 4 4 2 2 0 22	Contact Hours/ Week 3 4 5 5 2 2 2 30 22
SI. Course Code 1 B20AS0403 2 B20ER0401 3 B20ER0402 4 B20ER0403 5 B20ER0404 6 B20ER0405 7 B20MG0301 8 B20AS0303 9 B20AHM401	Title of the Course Laplace Transforms and Fourier Series Engineering Thermodynamics Material Science Manufacturing Science Mechanics of Materials Practical /Term Wood Communication Skill Indian constitution and Professional Ethics Advanced Kannada Basics of Kannada	HC/FC/SC OE FC HC	B20AS0 B20AS0 B20MEC TCTAL TOTAL TOTAL CL	nline otal	Cro L 3 2 3 /MOC 1 0 2 2 0 16 STER ATIVE	0 0 0 0 0 0 0 CRED CRED	P 0 1 1 1 0 0 0 6 ITS ITS	Total 3 4 4 2 0 22	Contact Hours/ Week 3 4 5 5 2 2 2 2 30 22 84

SI Course		SEMESTER-	.5 Dro	Cı	redit	Patt	ern &	Contact
No Code	Title of the Course	OE	requisite	L	Cred	dit Va P	lue Total	Hours/ Week
1 B20ER050	Design of Machine	HC		3	1	0	4	5
2 B20ER050	Fluid Mechanics and Machines	НС		2	1	0	3	4
3 B20ER050	Thermal Engineering Systems	НС		4	0	0	4	4
_	Pr	ofessional Ele	ctive-1					
B20ERS51	1 Smart Materials	SC	B20ER0302	3	0	0	3	3
B20ERS51	2 Experimental Stress Analysis	SC		3	0	0	3	3
4 B20ERS51	B Energy Technology	SC		3	0	0	3	3
B20ERS51	Automotive Engineering	sc	>	3	0	0	3	3
B20ERS51	Statistical Quality Control	sc		3	0	0	3	3
	Open Electiv	e-1 for other	school stude	nts	1 -		<u> </u>	T .
5 B20MEO50	1 Smart Materials	De OE	locations /Onlin	3	0	0	3	3
	Flow Analysis Heing	ractice S	essions/Unlif	ie/IV	100	<u>_</u>		
6 B20ER050	4 Ansys Fluent	HC		1	0	1	2	3
7 B20ER050	5 Fluid Machines Lab	НС		0/	0	1	1	2
8 B20ER050	6 Heat Engine Lab	HC		0	0^	1	1	2
9 B20PA050	1 Indian Tradition and Culture	FC		1/	0	0	1	1
		\leftarrow	TOTAL	17	2	3	/22	27
		TO	TAL CUMULA	TIVE	CRE	DITS/		106
		10	TOTAL CON	ITACT	CKE	LIRS		27
	Title of the Course Design of Machine Elements Fluid Mechanics and Machines Thermal Engineering Systems Pr Smart Materials Experimental Stress Analysis Energy Technology Automotive Engineering Statistical Quality Control Open Elective Smart Materials Practical / Term Word Flow Analysis Using Ansys Fluent Fluid Machines Lab Heat Engine Lab Indian Tradition and Culture							

			SEMESTER-6		ı				
SI. No	Course Code	Title of the Course	HC/FCSC/OE	Pre requisite	Cr	edit Cred	Patt lit Va	ern &	Contact Hours/
1	R20FR0601	Heat Transfer	HC	B20ER0301	L 2	1 1	P	Total	Week
2	B20ER0602	Finite Element	HC	B20ER0304	2	1	0	3	4
3	R20FR0603	Methods Design of Transmission	нс	R20FR0501	3	0	0	3	3
	BEGENOOOS	Elements	fossional Electiv	10.3		Ľ			
	B20ERS611	Title of the Course Heat Transfer Finite Element Methods Design of Transmission Elements Pro Product Design by Additive Manufacturing Design for Manufacturing and Assembly Turbomachines Electric and Hybrid Vehicles Production and Operations Management Pro Automation in Manufacturing Robotic Systems Kinematics Refrigeration and Air Conditioning Aircraft Fundamentals Industrial Engineering Open Elective Energy Technology Practical /Term Worl Heat Transfer Lab Computer Aided Engineering Analysis Lab Technical Documentation Research Based Mini Project	SC SC	/e-2	3	0	0	3	3
	B20ERS612	Design for Manufacturing and Assembly	SC		3	0	0	3	3
4	B20ERS613	Turbomachines	SC	B20ER0502	3	0	0	3	3
	B20ERS614	Electric and Hybrid Vehicles	sc		3	0	0	3	3
	B20ERS615	Production and Operations Management	sc	B20ERS515	3	0	0	3	3
		Pro	fessional Electiv	/e-3					
	B20ERS621	Automation in Manufacturing	sc		3	0	0	3	3
_	B20ERS622	Robotic Systems Kinematics	sc		3/	0	0	3	3
5	B20ERS623	Refrigeration and Air Conditioning	sc		/3	0	0	3	3
	B20ERS624	Aircraft Fundamentals	sc		3	0	0	3	3
	B20ERS625	Industrial Engineering	sc		3	0/	0	3	3
	D2014E0C01	Open Elective	e-2 for other sc	hool students	1	Τ_0	_		2
- 0	PZUIVIEUOUI	Practical /Term Wor	k / Practice Ses	sions/Online	 ′МО(oc	U	3	3
7	B20ER0604	Heat Transfer Lab	HC		0	0	1	1	2
8	B20ER0605	Computer Aided Engineering Analysis Lab	нс		0	0	1	1	2
9	B20ER0606	Technical Documentation	FC		1	0	0	1	1
10	B20ER0607	Research Based Mini Project	НС		0	0	1	1	3
				TOTAL FOTAL SEMES	17 TER (2 CRED	3 ITS	22	28 22
			TO	TAL CUMULAT	IVE (CRED	ITS		128
				TOTAL CONT	ΓΑСΤ	ΗΟι	JRS		28

No	Si, No Course Code Title of the Course SC/OE Frequisite Credit Value Hours/ Week	SEMESTER-7 SL	No
B20ER0701	B20ER0701	1 B20ER0701 Vibrations and Noise HC 2 1 0 3 4	B20ER0701
B20ER0702 CAD/CAM/CIM	2 B20ER0702 CAD/CAM/CIM	2 B20ER0702 CAD/CAM/CIM HC 2 1 0 3 5 3 B20ER0703 Control Systems Candidate HC 3 0 0 3 3 4 B20ER0704 Engineering Economics And Financial HC 3 0 0 3 3 5 Professional Elective-4	B20ER0702 CAD/CAM/CIM
B20ER0703 Mechatronics Accounted Systems B20ER0704 B20ER0705 B20ER0706 B20ER0705 B20ER0705 B20ER0706 B20ER0705 B20ER0706 B20ER0705 B20ER0706 CIM and Machine Learning Lab HC D D D D D D D D D	B20ER0703 Mechatronics Acontrol Systems HC	Bauer Baue	B20ER0703 Mechatronics and Control Systems Engineering Economics and Financial HC 3 0 0 3 3 3 3 3 3 3
B20ER0704 B20ER0704 B20ER0704 B20ER0704 B20ER0704 B20ER0704 B20ER0711 B20ER0712 B20ER0712 B20ER0713 B20ER0713 B20ER0714 B20ER0714 B20ER0715 B20ER0715 B20ER0715 B20ER0716 B20E	Engineering Economics and Financial HC 3 0 0 3 3	Engineering Economics A B20ER0704 Management B20ERS711 Learning In Learning In Machine Learning In Management SC 3 0 0 3 3 3 3 3 3 3	B20ER0704 Engineering Economics and Financial HC 3 0 0 0 3 3 3
B20ERS711	B20ERS711	B20ERS711	B20ERS711
B20ERS711	B20ERS711	B20ERS712	B20ERS711
B20ERS712 Robotic Systems Dynamics and Control SC B20ERS6 3 0 0 3 3 3 3 3 3 3	B20ERS712 Robotic Systems Dynamics and Control SC 22 3 0 0 3 3 3 3 3 3 3	B20ERS712 Robotic Systems Dynamics and Control SC 22 3 0 0 3 3 3 3 3 3 3	B20ERS712 Robotic Systems Dynamics and Control SC B20ERS6 3 0 0 3 3 3 3 3 3 3
B20ERS713 Computational Fluid Dynamics SC 3 0 0 3 3 3 3 SC B20ERS714 Micro Mechanical Systems SC SC SC SC SC SC SC S	B20ERS713 Computational Fluid Dynamics SC 3 0 0 3 3 3 3 3 3 3 3 3	B20ERS713 Computational Fluid Dynamics SC 3 0 0 3 3 3 3 S	B20ERS713 Computational Fluid Dynamics SC 3 0 0 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
B20ERS714 Micro Electro Mechanical Systems SC Mechanical Systems Total Quality Management and Six SC Sigma Sig	B20ERS714 Micro Electro Mechanical Systems Total Quality Management and Six SC B20ERS6 15 3 0 0 3 3 3 3 3 3 3	B20ERS714 Micro Mechanical Systems Total Quality B20ERS6 Sigma Six SC Sigma Six	B20ERS714 Micro Electro SC 3 0 0 3 3 3
B20ERS715 Management and Six SC B20ERS6 15 3 0 0 3 3 3	B20ERS715	B20ERS715 Management and Six SC B20ERS6 15 3 0 0 3 3 3 3 3 3 3	B20ERS715 Management and Six SC B20ERS6 15 3 0 0 3 3 3
B20ERS716	B20ERS716 Internship Phase-1 SC	B20ERS716 Internship Phase-1 SC	B20ERS716 Internship Phase-1 SC 0 0 3 3 3 3
B20ERS721	B20ERS721	B20ERS721	B20ERS721
B20ERS721 Fluid Power SC 3 0 0 3 3 3 3 3 3 3	B20ERS721 Fluid Power SC 3 0 0 3 3 3 3 3 3 3	B20ERS721 Fluid Power Engineering SC 3 0 0 3 3 3 3 3 3 3	B20ERS721 Fluid Power SC 3 0 0 3 3 3 3 3 3 3
B20ERS722 Tribology SC 3 0 0 3 3 3 3 3 3 3	B20ERS722 Tribology SC 3 0 0 3 3 3 3 3 3 4 0 0 3 3 3 3 3 3 3 3	B20ERS722 Tribology SC 3 0 0 3 3 3 3 3 3 3	B20ERS722 Tribology SC 3 0 0 3 3 3 3 3 3 3
B20ERS724 Autonomous Vehicles SC 3 0 0 3 3 3 3 3 3 3	B20ERS724 Autonomous Vehicles SC 3 0 0 3 3 3 3 3 3 3	B20ERS724	B20ERS724 Autonomous Vehicles SC 3 0 0 3 3 3 3 3 3 3
B20ERS725 Operation Research SC 3 0 0 3 3 3 3 3 3 3	B20ERS725 Operation Research SC 3 0 0 3 3 3	B20ERS725 Operation Research SC 3 0 0 3 3 3	B20ERS725 Operation Research SC 3 0 0 3 3 3 3 3 3 3
B20ERS726 Internship SC 0 0 3 3 3 3 3	B20ERS726 Internship SC	B20ER5726 Internship SC	B20ERS726 Internship SC 0 0 3 3 3 3 3
Total Contact Hours Open Elective-3 for other school students Total Contact Hours Open Electric and Hybrid Vehicles Open Electric and Hybrid Vehicles Open Electric and Hybrid Open Electric and Hybrid Vehicles Open Electric and Hybrid Open Electric and Hybrid Open Electric Archive Open Electric and Hybrid Open Electric Archive Open Electric Arch	Second Company Compa	Secretary Secr	Second Color Seco
Total Contact Hours Total Contact Hours	R20MEO701 Electric and Hybrid Vehicles 3 0 0 3 3 3	Received Received	Total contact Hours Total contact Hours
Practical / Term Work / Practice Sessions/Online / MOOC 8	Section Practical Term Work Practice Sessions Online MOOC	S B20ER0705 Design Lab HC 0 0 1 1 2	Practical / Term Work / Practice Sessions/Online / MOOC 8
9 B20ER0706 CIM and Machine HC 0 0 1 1 2 TOTAL 20 1 2 23 26 TOTAL SEMESTER CREDITS 23 TOTAL CUMULATIVE CREDITS 151 TOTAL CONTACT HOURS 26	S S20ER0706 CIM and Machine HC 0 0 1 1 2 2 2 2 2 2 2 2	S B20ER0706 Design Lab HC 0 0 1 1 2 2 2 3 26	9 B20ER0706 CIM and Learning Lab Machine Learning Lab HC 0 0 1 1 2 TOTAL SEMESTER CREDITS 23 26 TOTAL CUMULATIVE CREDITS 151 TOTAL CONTACT HOURS 26
TOTAL 20 1 2 23 26 TOTAL SEMESTER CREDITS 23 TOTAL CUMULATIVE CREDITS 151 TOTAL CONTACT HOURS 26	TOTAL 20 1 2 23 26 TOTAL SEMESTER CREDITS 23 TOTAL CUMULATIVE CREDITS 151 TOTAL CONTACT HOURS 26	TOTAL 20 1 2 23 26	TOTAL 20 1 2 23 26 TOTAL SEMESTER CREDITS 23 TOTAL CUMULATIVE CREDITS 151 TOTAL CONTACT HOURS 26
TOTAL CUMULATIVE CREDITS 151 TOTAL CONTACT HOURS 26	TOTAL CUMULATIVE CREDITS 151 TOTAL CONTACT HOURS 26	TOTAL CUMULATIVE CREDITS 151 TOTAL CONTACT HOURS 26	TOTAL CUMULATIVE CREDITS 151 TOTAL CONTACT HOURS 26
TOTAL CONTACT HOURS 26			

SI.	Course	Title of the Course	HC/FC/SC	Pre			Patt lit Va	ern & ilue	Contact		
No	lo Code	Title of the Course	/ OE	requisit e	L	т	Р	Tota I	Hours/ Week		
		Open Elective-4 fo	or other school	ol students							
1	B20MEO80 1	Total Quality Management and Six Sigma		3	0	0	3	3			
Practical /Term Work / Practice Sessions/Online /MOOC											
2	B20ER0801	Major Project	HC		0	0	6	6	18		
				TOTAL	3	0	6	9	21		
	TOTAL SEMESTER CREDITS 9										
	_	·		TOTAL CUMUI	LATIV	E CRE	DITS		160		
				TOTAL CO	ONTA	ст но	URS	21			

	SEN	/IESTER-8						
SI. Course No Code	Title of the Course Open Elective-4 for Total Quality Management and Six Sigma Practical /Term Work / Production and Six Sigma Practical /Term Work / Product Design by Additive Design for Manufacturing Turbomachines Electric and Hybrid Vehice Production and Operation Automation in Manufacturing Automatical Automation in Manufacturing Automatical Autom	HC/FC/SC / OE	Pre requisit e	Cr L	edit Credi	Patt it Va P	ern & lue Tota	Contact Hours/ Week
	Onen Flective-4 fo	r other scho	 students				I	
1 B20MEO80 1	Total Quality Management and Six Sigma	OE	J. Students	3	0	0	3	3
2 P20EP0901	Practical /Term Work / Pr	ractice Sessio	ns/Online /	/MO	oc	6	6	10
Z BZUERUOUI	Major Project	пс	TOTAL	3	0	6	9	21
			TOTAL SEN	IESTER	R CRED	ITS		9
			TOTAL COMO	ONTAC	CT HOU	JRS		21
		\wedge						
ist of Professional Ele	ctives					1		
SI. No Course Co	de Title	of the Course	!]		
1 B20ERS511	Smart Materials					1		
2 B20ERS512 3 B20FRS513	Experimental Stress Anal	ysis						
4 B20FRS514	Automotive Engineering					1		
5 B20FRS515	Statistical Quality Contro			/		1		
6 B20ERS611	Product Design by Addition	ve Manufactu	ring			1		
7 B20FRS612	Design for Manufacturing	and Assemb	ly.	/				
8 B20FRS613	Turbomachines	, , 13501110			^			
9 R20FRS614	Flectric and Hybrid Vehic	// les	<u> </u>	/				
10 R20FRS615	Production and Operation	ns Manageme	ent	\wedge		/		
11 R20FDS621	Automation in Manufacts	ıring						
12 R20ER3023	Robotic Systems Kinemat	ring			<u> </u>			
13 R20FRS623	Refrigeration and Air Con	ditioning						
14 R20FRS624	Aircraft Fundamentals	artioning	\rightarrow	>				
15 R20ER3024	Industrial Engineering	/	//_					
16 P20ER3023	InT and Machine Joanning	y in Manufact	airing					
17 B20EBS713	Robotic Systems Dynamic	cs and Contro	.urmg .l					
19 D20ER3/12	Computational Fluid Dum	ania contro	· ·			1		
10 B2UER3/13	Micro Flactro Machanica	L Systems				1		
20 D20ER3/14	Total Quality Management	nt and Civ Cia	ma					
21 D20EBS715	Internship Phase 1	it allu SIX SIBI	ıııa			1		
21 B2UER3/10	Fluid Dower Engineering							
22 B20ER3/23	Trihology							
24 R20FRS722	Solar Fnergy Systems							
25 R20FRS723	Autonomous Vahicles							
26 B20ER3/24	Operation Passarch							
27 R20FRS72	Internshin							
ist of Open Flective C	ourses					J		
tef: BOS/SME/BME-2020-2	Title of the Course Open Elective-4 fc Total Quality Management and Six Sigma Practical /Term Work / Properties Experimental Stress Analogue Experimental Stress Analogue Energy Technology Automotive Engineering Statistical Quality Controgue Product Design by Addition Design for Manufacturing Turbomachines Electric and Hybrid Vehice Production and Operation Automation in Manufacturing Refrigeration and Air Congulation Automation in Manufacturing Robotic Systems Kinemator Refrigeration and Air Congulation Aircraft Fundamentals Industrial Engineering IoT and Machine Learning Robotic Systems Dynamical Computational Fluid Dynamical Robotic Systems Dynamical Robotic Systems Dynamical Computational Fluid Dynamical Robotic Systems Dynamical Computational Fluid Dynamical Robotic Systems Dynamic	3-25.06.22/2023 40	3-24-10.06.23					

1 B20CEO50 2 B20CEO60 3 B20CEO70 4 B20CEO80 5 B20CIO501 6 B20CIO502	1 5 1 6 1 7	Open Elective Course Name BUILDING MATERIALS AND CONSTRUCTION BUILDING PLANNING AND BYE LAWS DISASTER PREPAREDNESS, PLANNING AND MANAGEMENT ROAD SAFETY AND MANAGEMENT INTRODUCTION TO AI OOPS WITH C++ WEB TECHNOLOGY DATA MINING MACHINE LEARNING NEURAL NETWORKS DEEP LEARNING PYTHON FOR DATA SCIENCE IOT PROGRAMMING REINFORCEMENT LEARNING DATA STRUCTURES JAVA PROGRAMMING R PROGRAMMING LANGUAGE SENSORS AND INSTRUMENTATION MICROPROCESSORS AND MICROCONTROLLERS AUTOMOTIVE ELECTRONICS ROBOTICS AND AUTOMATION ENERGY CONSERVATION ELECTRICAL SAFETY AND REGULATIONS RENEWABLE ENERGY SYSTEM TROUBLE SHOOTING OF COMMON	CF	-
2 B20CEO60 3 B20CEO70 4 B20CEO80 5 B20CIO503 6 B20CIO503	1 6	BUILDING PLANNING AND BYE LAWS	CL	All Engineering
3 B20CEO70 4 B20CEO80 5 B20CIO503 6 B20CIO503	1 7	DOLDING I EANIMING AND DIE EAWS	CF	All Engineering
4 B20CEO80 5 B20CIO503 6 B20CIO503	1 0	DISASTER PREPAREDNESS, PLANNING AND	CE	All Engineering
5 B20CIO501	1 0	ROAD SAFETY AND MANAGEMENT	CE	All Engineering
6 B20CIO502	5	INTRODUCTION TO AI	CI	Mech, Civil, ECE,E
	. 5	OOPS WITH C++	CI	Mech, Civil, ECE,E
7 B20CIO503	5	WEB TECHNOLOGY	CI	Mech, Civil, ECE,E
8 B20ClO601	6	DATA MINING	CI	Mech, Civil, ECE,E
9 B20ClO602	6	MACHINE LEARNING	CI	Mech, Civil, ECE,E
10 B20CIO603	6	NEURAL NETWORKS	CI	Mech, Civil, ECE,E
11 B20CIO701	. 7	DEEP LEARNING	CI	Mech, Civil, ECE,E
12 B20CIO702	7	PYTHON FOR DATA SCIENCE	CI	Mech, Civil, ECE,E
13 B20CIO801	8	IOT PROGRAMMING	CI	Mech, Civil, ECE,E
14 B20CIO802	8	REINFORCEMENT LEARNING	CI	Mech, Civil, ECE,E
15 B20CSO50	L 5	DATABASE MANAGEMENT SYSTEMS	CS	All Engineering
16 B20CSO60	L 6	DATA STRUCTURES	CS	All Engineering
17 B20CSO70	L 7	JAVA PROGRAMMING	CS	All Engineering
18 B20CSO80	1 8	R PROGRAMMING LANGUAGE	CS	All Engineering
19 B20ECO50	1 5	SENSORS AND INSTRUMENTATION	EC	All Engineering
20 B20ECO60	1 6	MICROPROCESSORS AND MICROCONTROLLERS	EC	All Engineering
21 B20ECO80	1 7	AUTOMOTIVE ELECTRONICS	EC	All Engineering
22 B20ECO80	2/ 8 /	ROBOTICS AND AUTOMATION	EC	All Engineering
23 B20EEO50	L 5 /	ENERGY CONSERVATION	EE	All Engineering
24 B20EEO60	6	ELECTRICAL SAFETY AND REGULATIONS	EE/	All Engineering
25 B20EEO80	L 7	RENEWABLE ENERGY SYSTEM	ΕÉ	All Engineering
26 B20EEO80	2 8	TROUBLE SHOOTING OF COMMON ELECTRICAL APPLIANCES	EE	All Engineering
27 B20MDO5)1 5	BIOPYTHON	MD	All Engineering
28 B20MD06	01 6	BIOSENSORS AND BIOELECTRONICS	MD	All Engineering
29 B20MD07	01 7	COGNITIVE NEUROSCIENCE	MD	All Engineering
30 B20MD08	01 8	CYBER SECURITY AND FORENSICS	MD	All Engineering
31 B20MEO50	1 5	SMART MATERIALS	ME	All Engineering
32 B20MEO60	1 6	ENERGY TECHNOLOGY	ME	All Engineering
33 B20MEO70	1 7	ELECTRIC AND HYBRID VEHICLES	ME	All Engineering
34 B20ME080	8	ENERGY CONSERVATION ELECTRICAL SAFETY AND REGULATIONS RENEWABLE ENERGY SYSTEM TROUBLE SHOOTING OF COMMON ELECTRICAL APPLIANCES BIOPYTHON BIOSENSORS AND BIOELECTRONICS COGNITIVE NEUROSCIENCE CYBER SECURITY AND FORENSICS SMART MATERIALS ENERGY TECHNOLOGY ELECTRIC AND HYBRID VEHICLES TOTAL QUALITY MANAGEMENT AND SIX SIGMA 21-22-05.06.21/2022-23-25.06.22/2023-24-10.06.23 41	ME	All Engineering

Course Title	Differential I	Equations	and Linear A	Algebra	Course	Туре		FC	
Course Code	B20AS0103	Credits	3		Cla	ISS	I semester		
	TLP	Credits	Contact	Work	Total Nu	mber of	A		
	ILP	Credits	Hours	Load	Clas	ses	Assessment in		
Course	Theory	3	3	3	Per Ser	mester	Weightage		
Structure	Practice	0	0	0	Theory	Dunatical	1.0	CEE	
	Tutorial	0	0	0	Theory	Practical	IA	SEE	
	Total	3	3	3	39	0	50%	50%	

			Detail	ed Syllabus	5				
			1 st S	Semester					
Course Title	Differenti	al Equation	s and Linea	ır Algebra		Course	Туре		FC
Course Code	B20AS010	3 Credits		3		Cla	SS	l se	mester
	TLP	Credits	Contact Hours	Work Load	То	tal Nui Clas	mber of ses	Asses We	ssment in ightage
Structure	Practice	0	0	0	Tho	er sen	Dractical	10	CEE
	Tutorial	0	0	0	The	ory	Practical	IA	SEE
	Total	3	3	3	39	9	0	50%	50%
Course Title Course Code Course Structure COURSE OVERV This course is in course covers id applications to desolving linear sy. COURSE OBJECT 1. To impart the engineering 2. To impart the engineering 3. To study different to course COURSE OUTCO After the complete COURSE OUTCO COURSE COUR	he Knowledge he Knowledge ferent method en values and	of first ord of higher of s to solve of Eigen vecto	er ordinary order linear onsistent sy rs using nu	y differenti differentia ystem of ala merical me	al equat al equat gebraic o thod, di	cions a cions a equationa	nd its applicend its applicens.	ations in ations in canonica	the field of the f
After the comple	etion of the co	urse, the stu	ident will b	e able to:					
CO Course	Outcomes	<u> </u>	//	/ / /				POs	PSOs
CO1 Recogn	ize and solve 1	irst-order o	rdinary diff	erential en	uations	.//	^_/	1. 2	1
Analyz	and solve dif	ferential eq	uations of e	.1		$\overline{}$			
	. and solve ull	i er erruar eq		אויים וראו ביו	rcuite fo	orced b	scillation		
of mas	s spring and el	ementary h	eat transfer	r.	rcuits, fo	orced o	scillation	1, 2	1
cO3 of mas Summa differe	s spring and elerize matrices that areas of Line	ementary ho techniques f ear Algebra.	eat transfer for solving s	r. systems of	linear e	quatio	ns in the	1, 2	1
cO3 of mas Summa differe Execut Eigen v	s spring and el arize matrices a nt areas of Line ng the technic ector.	ementary ho techniques f ear Algebra. Jues to dete	eat transfer for solving s rmine large	systems of	linear ed	quation corres	ns in the	1, 2 1, 2, 5 1, 2, 5	1 1 1
cO3 Summa differe CO4 Execut Eigen v	s spring and el nrize matrices in nt areas of Line ng the technic ector. OF THE COUR	ementary hotechniques fear Algebra. Jues to dete	eat transfer for solving s rmine large	systems of est Eigen va	linear ed	quation corres	ns in the sponding	1, 2 1, 2, 5 1, 2, 5	1 1 1
cO3 Summa differe CO4 Execut Eigen v	arize matrices on areas of Line on the technic ector. OF THE COUR	ementary hotechniques fear Algebra. Jues to dete	eat transfer for solving s rmine large	systems of est Eigen va	linear ed	quation corres	ns in the sponding	1, 2 1, 2, 5 1, 2, 5	1 1 1
cO3 of mas CO3 Summa differe Execut Eigen v BLOOM'S LEVEL R CO	arize matrices on the areas of Line on the technic ector. OF THE COUR emember (L1)	ementary hotechniques fear Algebra. Jues to dete SE OUTCON Understar (L2)	rmine large	Bloom's pply (L3)	linear ed	quation corres	escillation Ins in the Exponding Evaluate (L5)	1, 2 1, 2, 5 1, 2, 5	1 1 Create (L6)
cos of mas Summa differe CO4 Execut Eigen v BLOOM'S LEVEL CO CO1	arize matrices in areas of Line ing the technic ector. OF THE COUR emember (L1)	ementary hotechniques fear Algebra. Jues to dete SE OUTCON Understar (L2)	rmine large	Bloom's pply (L3)	linear ed	quation corres	escillation Ins in the Evaluate (L5)	1, 2 1, 2, 5 1, 2, 5	1 1 1 Create (L6)
of mas CO3 Summa differe Execut Eigen v BLOOM'S LEVEL CO CO1 CO2	arize matrices int areas of Line ing the technic ector. OF THE COUR emember (L1)	ementary hotechniques fear Algebra. Jues to dete SE OUTCOM Understar (L2)	rmine large	Bloom's pply (L3)	linear ed	quation corres	Evaluate (L5)	1, 2	1 1 1 Create (L6)
cO3 Summa differe CO4 Execut Eigen v BLOOM'S LEVEL CO CO1 CO2 CO3	arize matrices in areas of Line ing the technic ector. OF THE COUR emember (L1)	ementary hotechniques from techniques for algebra. It is to determine the sear Algebra. It is to determine the sear Algebra for algebra.	rmine large	Bloom's pply (L3)	linear ed	quation corres	Evaluate (L5)	1, 2	1 1 1 Create (L6)
cO3 Summa differe CO4 Execut Eigen v BLOOM'S LEVEL CO CO1 CO2 CO3 CO4	arize matrices intareas of Line ing the technic ector. OF THE COUR emember (L1)	ementary hotechniques from techniques for the ear Algebra. It is to detect the second	rmine large	Bloom's pply (L3)	linear ed	quation corres	Evaluate (L5)	1, 2	1 1 1 Create (L6)
CO3 Summa difference Execut Eigen von CO4 CO1 CO2 CO3 CO4 COURSE ARTICLE	s spring and elements of Line interest o	ementary hotechniques from techniques for the ear Algebra. It was to determine the company of the ear Algebra. It was to determine the ear Algebra for the ear Algebra.	rmine large	Bloom's pply (L3) ✓	linear ed	quation corres	Evaluate (L5)	1, 2	1 1 1 Create (L6)
of mas CO3 Summa differe Execut Eigen v BLOOM'S LEVEL CO CO1 CO2 CO3 CO4 CO4 COURSE ARTICL CO/ POS To The control of the control	arize matrices int areas of Line ing the technic ector. OF THE COUR emember (L1) LATION MATE	ementary hotechniques from Algebra. Illues to dete	rmine large	Bloom's pply (L3)	Level Analy (L4)	quation (correspondent)	Evaluate (L5)	1, 2 1, 2, 5 1, 2, 5	1 1 1 Create (L6) 80 80 80 80 80 80 80 80 80 80 80 80 80
CO3 Summa differe CO4 Execut Eigen v BLOOM'S LEVEL CO CO1 CO2 CO3 CO4 COURSE ARTICL CO/ POs CO1 3	s spring and elemize matrices into areas of Line ing the technic ector. OF THE COUR emember (L1) V LATION MATE	ementary hotechniques for Algebra. Jues to dete SE OUTCON Understar (L2)	rmine large	Bloom's pply [L3)	Level (L4)	quation corres	Evaluate (L5)	1, 2 1, 2, 5 1, 2, 5	1 1 1 Create (L6) 80 80 80 2
Course Title Course Code Course Structure COURSE OVERV This course is in course covers is applications to desolving linear sy. COURSE OBJECT 1. To impart the engineering and the engineering and the engineering and the engineering and the course	emember (L1) V LATION MATE	ementary hotechniques for Algebra. Jues to dete SE OUTCON Understar (L2)	rmine large	Bloom's pply [L3)	Level Analy (L4)	quation corres	Evaluate (L5)	1, 2 1, 2, 5 1, 2, 5	1 1 1 Create (L6) 80 80 80 2 2 2

			Bloom'	s Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓	✓	✓		✓	
CO2		✓	✓		✓	
CO3	✓	✓	✓		✓	
CO4		✓	✓		✓	

CO/ POs	PO1	P02	PO3	P04	PO5	90d	PO7	PO8	60d	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	2												2	
CO2	3	2												2	

CO3	3	2		1					2	
C04	3	2		1					2	
Average	3	2		1					2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit -1

Differential equations of First order and first degree: (Recap: Variable separable, Homogenous and Linear equations) Bernoulli's equation, Exact Differential Equations, Equation reducible to exact [IF for the case of $\frac{1}{M} \left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x} \right)$ and $\frac{1}{N} \left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x} \right)$ only].Orthogonal trajectories (both Cartesian and polar form), Engineering applications.

Unit – 2

Linear differential equations:Linear differential equations with constant coefficients: inverse differential operator method and method of variation of parameters. Linear differential equations with variable coefficients: Solution of Cauchy's and Legendre's linear differential equations, engineering applications.

Unit - 3

Linear Algebra: Rank of Matrix by elementary transformations, Linear System of Equations, Conditions of Existence and Uniqueness of Solutions. Solution of linear system of equations by Gauss Elimination, Gauss – Jordan and Gauss-Seidel method, Engineering applications.

Unit – 4

Matrix theory: Eigen Values and Eigen Vectors, Rayleigh's power method to find the largest Eigen value and the corresponding Eigen vector. Linear transformation, diagonalization of a square matrix. Reduction of Quadratic form to Canonical form, engineering applications.

TEXT BOOKS

- 1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Reprint edition, 2013
- 2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015

REFERENCE BOOKS

- 1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th Edition, 2013.
- 2. P.V. O'Neil, "Advanced Engineering Mathematics", Thomson Mathematical Methods by Potter & Goldberg; Publisher: PHI.

JOURNALS / MAGAZINES:

- 1. https://www.journals.elsevier.com/journal-of-differential-equations
- 2. https://www.journals.elsevier.com/linear-algebra-and-its-applications

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/111/106/111106051/
- 2. https://nptel.ac.in/courses/111/104/111104031/
- 3. https://www.coursera.org/learn/differential-equations-engineers

Course Title		Physics for	Engineers		Cour	se Type	FC		
Course Code	B20AS0107	Credits	4	ļ	С	lass	I semester		
	TLP	Credits	Contact Work Total Number of		umber of	Assessm	ont in		
	ILF	Credits	Hours	Load	Cla	isses	Weightage		
Course Structure	Theory	3	3	3	Per Se	emester			
Course structure	Practice	1	2	2	Theory	Practical	IA	SEE	
	Tutorial	0	0	0	THEOLY	Fractical	IA	JEE	
	Total	4	5	5	40	26	50 %	50 %	

Course Title Physics for Engineers Course Type FC Course Code B20A50107 Credits 4 Class Isemester TLP Credits Course Code Classes Table	Course Structure	Course Code B20A	Ph	nysics for E	ngineers		Course	е Туре	F	C
Course Structure TLP	Course Structure TLP	l	AS0107	Credits		4	Cla	ass	I sem	ester
Theory 3 3 3 3 Per Semester Practice 1 2 2 1 Theory Practice 1 1 2 2 2 Theory Practice 1 2 2 2 Theory Practical IA SEE COURSE OVERVIEW Fundamental Physics is very important and necessary basic subject for all branches of engineering students. It provides the fundamental knowledge of basic principles of Physics which is required for basic foundation engineering education irrespective of branch. This course introduces the basic concepts of Physics and its applications to Mechanical Engineering courses by emphasizing the concepts underlying four units .1 Lasers and optical fibers , 2.Quantum effects like blackbody radiations, photoelectric effect , electromagnetic radiations .Quantum mechanics and its applications .4.Theories of solids to explain electrical properties of materials (Conductors, semiconductors, insulators and superconductors) etc This subject has basic laws expressions and theories which helps to increase the scientific knowledge to analyze upcoming technologies. This course enables graduating students 1. To understand the basic concepts and principles of Physics to analyze practical engineering problems and apply its solutions effectively and efficiently. 2. To gain the knowledge of different physical phenomena, quantum/wave mechanics and materials science. 3. To understand design issues, practical oriented skills and problem solving challenges. COURSEOUTCOMES (Cos) After the completion of the course, the student will be able to: CO Course Outcomes Pois PSOs Explain CO ₂ and semiconductor laser working and applications. CO ₃ Explain CO ₂ and semiconductor laser working and applications. CO ₄ Co ₄ Explain CO ₅ and semiconductors and derive expression for NA, number of 1, 9, 10 2, 3 COMPATIBLE (Cos) Analyze quantum effects like blackbody radiations , photoelectric effect, electromagnetic radiations and compatible effects and compatible effects and compatible effects and compatible effe	Theory 3 3 3 3 7 Peractice 1 2 2 2 Theory Practical IA SEE Trutorial 0 0 0 0 0 Theory Practical IA SEE Trutorial 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Т	TLP	Credits	Contact	Work	Total Nu	imber of	Assessi	ment in
COURSE OVERVIEW Function 1	Course Structure Practice 1 2 2 2 Theory Practical 1A SEE	The	neory.	3	Hours	Load	Clas	sses mester	Weig	htage
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C04	C04	CO2 Analyze of effect, e CO3 Interpret CO4 materials supercor BLOOM'S LEVELOF TH CO Remei (L1) CO1 CO2	quantum eelectromag t laws of que e theories ls (Condinductors) ee HECOURSE	of solids uctors, setc. OUTCOME Understan (L2)	tions chanics and to explain semiconduces d Applications	d its applications of electrications, in Bloom's oply	ations behavior or sulators and Level Analyze (L4)	1, 2, 9, 1 1, 2 f 1 1, 2, 9,1 Evaluate (L5)	0 Cr.	2, 3 2, 3 2, 3 eate L6)
		CO2 Analyze of effect, e CO3 Interpret CO4 materials supercor BLOOM'S LEVELOF TH CO Remer (L1) CO1 CO2 CO3	quantum eelectromage t laws of queet theories (Condinductors) eember 1)	of solids uctors, setc. OUTCOME Understan (L2)	tions chanics and to explain semicondu	d its applications distributions distributio	ations behavior of sulators and Level Analyze (L4) ✓	1, 2, 9, 1 1, 2 f d 1, 2, 9,1 Evaluate (L5)	0 Cr.	2, 3 2, 3 2, 3 eate L6)
		CO2 Analyze of effect, e CO3 Interpret CO4 materials supercor BLOOM'S LEVELOF TH CO Remei (L1) CO1 CO2 CO3 CO4	quantum eelectromage t laws of queet theories ls (Condinductors) eember 1)	of solids uctors, setc. OUTCOME Understan (L2) ✓	tions chanics and to explain semiconduces d Ap (d its applications of electrications, in Bloom's oply L3)	ations behavior or sulators and Level Analyze (L4) ✓	1, 2, 9, 1 1, 2 f d 1, 2, 9,1 Evaluate (L5)	0 Cr.	2, 3 2, 3 2, 3 eate L6)
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		CO2 Analyze of effect, e CO3 Interpret CO4 materials supercon BLOOM'S LEVELOF TH CO Remer (L1 CO1 CO2 CO3 CO4	quantum eelectromage t laws of que theories ls (Condinductors) eember 1)	uantum me of solids uctors, setc. OUTCOME Understan (L2) ✓	tions chanics and to explain semicondu	d its applications of electrications in Bloom's oply L3)	ations behavior or sulators and Level Analyze (L4) ✓	1, 2, 9, 1 1, 2 f 1, 2, 9, 1 Evaluate (L5)	0 Cr. (2, 3 2, 3 2, 3 eate L6)

	Bloom's Level												
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)							
CO1	✓	✓	✓	✓									
CO2	✓	✓	✓	✓									
CO3	✓	✓	✓	✓									
C04	✓	✓	✓	✓									

COURSE ARTICULATIONMATRIX

CO/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	P09	PO10	PO11	P012	PSO1	PSO2	PSO3
CO1	3								2	1	1	1	3	3	1
CO2	3	2							1	1	1	1	3	3	1
CO3	3	2								1	1	1	3	3	1
C04	3	2							1	1	1	1	3	3	1
Average	3	2							1.3	1	1	1	3	3	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT THEORY

Unit-1

Lasers: Lasers Interaction between radiation and matter, Expression for energy density at thermal equilibrium in terms of Einstein's coefficients. Characteristics of laser light, Conditions for laser operation, Requisites of laser system, Construction and working of Carbon Dioxide (CO2) laser, semiconductor laser and Applications of laser. Optical fibers: Construction and light propagation mechanism in optical fibers, Acceptance angle, Numerical Aperture (NA), Expression for numerical aperture in terms of core and cladding refractive indices, Types of optical fibers, Attenuation and reasons for attenuation, optical fiber communication using block diagram, Advantages and limitations. Working of LED and Photodiode.

Unit-2

Electromagnetic Waves: Wave equation in differential form in free space. Plane electromagnetic waves in vacuum, their transverse nature. Polarization of electromagnetic waves (qualitatively)

Quantum Physics: Black body radiation spectrum, Stefan's law of radiation, Plank's quantum theory of radiation, verification of Weins law and Rayleigh Jeans law, using planks law. Wave Particle dualism, deBroglie hypothesis, Matter waves, Photoelectric effect, Compton Effect (qualitative).

Unit-3

Quantum Mechanics: Heisenberg's uncertainty principle, and its applications (nonexistence of electron inside the nucleus). Wave function, properties of wave function and physical significance. Probability density and Normalization of wave function, Schrodinger time independent wave equation, Eigen values and Eigen functions. Applications of Schrödinger wave equation – Particle in one dimensional infinite potential well with numerical examples.

Unit-4

Electron Theory of Metals: Classical free electron theory and its failures. Quantum Free electron theory and its success, density of states, Fermi-Dirac statistics (qualitative), Fermi factor, Fermi level, Fermi energy.

Physics of Semiconductor: Band structure – types of semiconductors-mention the expression for concentration of electrons and Holes in intrinsic semiconductors, Expression for electrical Conductivity of semiconductors in terms of energy gap and temperature. (Derivation)

Dielectric materials: polar and non-polar dielectrics, types of polarizations. Internal fields in a one dimensional solid dielectric (Derivation), Applications and Numerical problems.

Superconductivity and properties of superconductors.

PRACTICE:

SI. No.	
	Title of the Experiment
1.	Variation of Resistivity of intrinsic Semi-conductor crystal using four probe method
2.	Determination Value of Planck's constant by using light emitting diode
3.	Attenuation and propagation characteristics of optical fiber cable.
4.	Determination of numerical aperture of a given optical fiber.
5.	To find the laser parameters—wavelength and divergence of laser light by diffraction method.
6.	Photo Diode Characteristics (Study of I–V characteristics in reverse bias and variation of photocurrent as
0.	a function of reverse voltage and intensity
7.	Dielectric constant of a capacitor by charging and discharging of a capacitor
8.	Determination of particle size using laser.
9.	Band gap of intrinsic Semi-conductor
10.	Verification of Stefan's law of radiation by electrical method

TEXT BOOKS

- 1. M.N. Avadhanulu and P.G. Kshirsagar , "A Text book of Engineering Physics", S. Chand & Company Ltd, New Delhi, 10th revised Ed,.
- 2. Gaur and Gupta, "Engineering Physics", Dhanpat Rai Publications, 2017.

REFERENCE BOOKS

- 1. Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill Edù Pvt Ltd- New Delhi, 6th Edition, 2006
- 2. M K Verma, "Introduction to Mechanics", University Press (India) Pvt Ltd, Hyderabad, 2nd Edition, 2009.
- 3. B B laud, "Lasers and Non Linear Optics", New Age International Publishers, 3rd Edition, 2011
- 4. S O Pillai, "Solid State Physics", New Age International Publishers, 8th Edition, 2018.

Course Title	Intr	oduction to D	ata Scienc	æ	Cours	е Туре	Hard (Core
Course Code	B20CS0101	Credits		3 / _	/ CI	ass	I Semester	
	TLP	Credits	Contact Hours	Work Load		umber of asses	Assessm	nent in
Course	Theory	2 /	2	2	Per Se	emester	Weigh	tage
Course Structure	Practice	(1)	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0	meory	Tractical	1/4	JLL
	Total	3	4	4	26	26	50 %	50 %

COURSE OVERVIEW:

Data Science is an interdisciplinary, problem-solving oriented subject that is used to apply scientific techniques to practical problems. The course orients on preparation of datasets and programming of data analysis tasks. This course covers the topics: Set Theory, Probability theory, Tools for data science, ML algorithms and demonstration of experiments by using MS-Excel.

COURSE OBJECTIVES

The objectives of this course are to:

- 1. Explain the fundamental concepts of Excel.
- 2. Illustrate the use of basic concepts of Data Science in the real world applications.
- 3. Demonstrate the use of SQL commands in real world applications.
- 4. Discuss the functional components of Data Science for real world applications

COURSE OUTCOMES (Cos)

After the completion of the course, the student will be able to:

	CO	Course Outcomes	Pos	PSOs
	CO1	Make use of the concepts of Data Science in developing the real world	1, 2, 3, 4, 5	1,2,3
Ĺ		applications.	_, _, _, ., _	_,_,

CO2	Apply the SQL commands in developing the real-world applications.	1, 2, 3, 4, 5	1,2,3
CO3	Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data.	1, 2, 3, 4, 5	1, 2, 3
CO4	Create the real world AI based solutions using different machine learning algorithms	1, 2, 3, 4, 5	1, 2, 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level											
со	Remember(L1)	Remember(L1) Understand(L2) Apply(L3) Analyze(L4) Evaluate(L5) Create(L6)										
CO1			✓									
CO2			✓									
CO3			✓	✓								
CO4			✓ _	✓	✓	✓						

COURSE ARTICULATION MATRIX

CO/ Pos	P01	P02	PO3	P04	P05	904	P07	P08	604	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	3	2	2	2 /								3	3	3
CO2	2	2	2	2	2			/					3	3	3
CO3	3	3	2	2 <	2 <		\						3	3	3
C04	3	3	3	2	2								3	3	3
Average	2.8	2.8	2.3	_2	2								3	3	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY:

Unit/-1

Introduction to Microsoft Excel: Creating Excel tables, understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Filters, Grouping. Introduction to formulas and functions in Excel. Logical functions (operators) and conditions. Visualizing data using charts in Excel. Import XML Data into Excel How to Import CSV Data (Text) into Excel, How to Import MS Access Data into Excel, Working with Multiple Worksheets.

Unit -2

Introduction to Data Science: What is Data Science? Probability theory, bayes theorem, bayes probability; Cartesian plane, equations of lines, graphs; exponents.

Introduction to SQL: SQL: Creation, insertion, deletion, retrieval of Tables by experimental demonstrations. Import SQL Database Data into Excel

Unit -3

Data science Components: Tools for data science, definition of AI, types of machine learning (ML), list of ML algorithms for classification, clustering, and feature selection. Description of linear regression and Logistic Regression. Introducing the Gaussian, Introduction to Standardization, Standard Normal Probability Distribution in Excel, Calculating Probabilities from Z-scores, Central Limit Theorem, Algebra with Gaussians, Markowitz Portfolio Optimization, Standardizing x and y Coordinates for Linear Regression, Standardization Simplifies Linear Regression, Modeling Error in Linear Regression, Information Gain from Linear Regression.

Unit- 4

Data visualization using scatter plots, charts, graphs, histograms and maps: Statistical Analysis: Descriptive statistics- Mean, Standard Deviation for Continuous Data, Frequency, and Percentage for Categorical Data.

Applications of Data Science: Data science life cycle, Applications of data science with demonstration of experiments either by using Microsoft Excel.

PRACTICE:

Create and perform operations on Excel data set by applying Linear regression IS Excel Perform prediction and visualization of data Perform prediction and visualization of data
Technique
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f the E
Title o
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4.	Apply m depende input val	iultiple ent vari riables	linear reg able of a interest ra	ression to fictitious eate and und	predict the economy b employme	stock inc ased on nt rate.	dex price wh	nich is a ndent /	MS Excel	Perform prediction and
		Year 2020	month	interest rate	unemplo rat	oyment e	stock index price 1464			data
	Calculate HDFC ba with anr month a loan ava	e the to ank. Fo nual int as show ailed of Sl No.	otal interer example rerest rate in table Rs.10, 00,	st paid on e, Rs.10, 00 e of 5.2% below. Cal 000 during	a car loan v 0,000 has be and the cu culate the 3 years.	which has been born istomer r	been availe lowed from needs to par erest rate pa	ed from a bank y every id for a		Perform prediction and visualization of data Create Excel data and perform EMI estimator Creating Tables Creating and retrieving Tables Apply Linear regression
5.	-	1 2 3 4	Annual i Year of t Starting	nterest rat the loan payment r	e	Rs.10	,00,000 20% 3 1	<u>-</u>	MS Excel	perform EMI estimator
		6	Total int period	erest paid	during		?			
6.	Create a SUPPLIEI PINCODE PHONE_	supplion supplion in the supplication in the s	er databas IE, PRODU nere SU ould not b	se of 10 red JCTS, QUAI PPLIER_NA De NULL.	ords with NTITY, ADE ME, PRO	SUPPLIER DRESS, CIT DDUCTS,	_ID as prima TY, PHONE_I QUANTITY	ary key, NO and Y and	SQL	Creating Tables
7.	Create t primary and PIN CUSTOM	the cus key, C N_COD MER_NA	tomer da USTOMER E. Store IME and	tabase of R_NAME, Partical order	a big Mai HONE_NO twenty IO are m	rket with , EMAIL_ custome andatory	CUSTOMER ID, ADDRES 's details and displ	R_ID as S, CITY where ay the	SQL	Creating Tables Creating and retrieving Tables Apply Linear regression Apply Linear regression
8.	Apply lin amount details.	near reg	ression to	o find the w	eather (te ate your o	mperatur wn datak	e) of a city voase with fo	vith the Ilowing	MS Excel	Apply Linear
			CHY	Cen	tigrade	Cent	imeters			regression
9.	Use the l amount	of slee	egression p in hours Name Create you	technique Age ir own data	in Years base with	Sleep above de	of humans v in hours tails.	vith the	MS Excel	Apply Linear regression

10.	Apply the linear regression, compare the average salaries of batsman depending on the run rate scored/recorded in the matches. Assume your own database.		Apply Linear regression
11.	Design the ER diagram and create schema of the REVA library management	Entity	Entity
11.	system.	Relationship	Relationship
12.	Design the ER diagram and create schema for Hospital Management	Entity	Schema design
12.	system.	Relationship	Scrienia design

TEXT BOOKS

- 1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2015.
- Ramakrishnan and Gehrke , "Database Management systems", McGraw Hill Publications, 3rd Edition 2003.
- 3. Mastering Data Analysis in Excel https://www.coursera.org/learn/analytics-excel.
- 4. Kenneth N. Berk, Carey, "Data Analysis with Microsoft Excel", S. Chand & Company, 2004.

REFERENCE BOOKS

- 1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Edition, 2013.
- 2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th Edition, 2013.
- 3. Seymour Lipschutz, John J. Schiller, "Schaum's Outline of Introduction to Probability and Statistics", McGraw Hill Professional, 1998.

JOURNALS/MAGAZINES

- 1. https://www.journals.elsevier.com/computational-statistics-and-data-analysis
- 2. https://www.springer.com/journal/41060
- 3. International Journal on Data Science and Analytics
- 4. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8254253
- 5. IEEE Magazine on Big data and Analytics

SWAYAM/NPTEL/MOOCs

1. Excel Skills for Business: Essentials, Macquarie University (https://www.coursera.org/learn/excel-essentials)

- 2. SQL for Data Science, University of California, Davis (https://www.coursera.org/learn/sql-for-data-science)
- 3. Data Science Math Skills, Duke University (https://www.coursera.org/learn/datasciencemathskills)
- 4. https://www.edx.org/course/subject/data-science
- 5. https://onlinecourses.nptel.ac.in/noc19 cs60/preview

SELF-LEARNING EXERCISES

- 1. Relational database management system.
- 2. Advanced MS-Excel

Course Title	Introduction	to Enginee	ing Mech	anics	Cours	se Type	Hard	d Core
Course Code	B20ER0101	Credits		3	С	lass	l ser	nester
	TLP	Credits	Contact	Work	Total N	umber of	Accoca	ment in
	I LF	Credits	Hours	Load	Cla	asses		ghtage
Course	Theory	3	3	3	Per Se	emester	VVEI	giitage
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	THEOLY	riactical	IA IA	SEE
	Total	3	3	3	39	0	50 %	50 %

COURSE OVERVIEW:

The primary purpose of the study of Introduction to Engineering Mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering. This capacity requires more than a mere knowledge of the physical and mathematical principles of mechanics; also required is the ability to visualize physical configurations in terms of real materials, actual constraints and the practical

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ıımıtatior course is	is whic to heli	n goverr	i the b dent d	enavior levelon	ot mac	nines lity to	and st	ructure ze wh	es. One ich is s	of the to vital t	primar o prob	y objec Iem foi	tives i	n a me tion	cnanic
COURSE	OBJEC	FIVE	aciii o	icvelop	tills abi	iity to	Visuali	20, 1111	1011 13 3	o vicai c	o proc	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	imaia		
This cou	se en	ables gra	duatii	ng stud	ents to	ident	ify, an	alyze,	formul	ate, an	d solv	e engin	neerin	g probl	ems b
applying	princip	les of er	iginee	ring, Ma	athema	tics ar	nd Phys	ics.							
COURSE	OUTC	OMES (Co	os)			_									
After the	comp	etion of	the co	ourse, th	e stude	ent wil	ll be ab	le to:							
СО					Cours	e Out	comes						Pos	P	SOs
CO1	Deter	mine the	Resul	tant for	ce and	mome	ent for	a giver	ı syster	m of fo	rces.		1		1
CO2	Analy	ses and a	apply	the kno	wledge	e of ce	entroid	, and i	nomer	it of in	ertia fo	or	1,2	-	1,2
	Annly	knowlec	lge of	sunnort	reactio	on to f	ind rea	ction f	orces a	and ear	ıilibriy	m			
CO3	condi	ion for	differ	ent bea	ams an	nd also	o Ana	yses r	laner	and sr	atial 1	to	1,2	:	1.2
	deter	nine the	force	s in the	membe	er of tr	russes.								
	To eva	luate th	e fricti	ion force	es requ	ired to	hold	syste	m in sta	atic equ	ilibriu	m			
CO4	and al	so deter	mine t	he prop	erties	of a sy	stem o	r its lo	ds for	which a	syste	m	1,2	:	1,2
	will be	in a cor	ndition	of impo	ending	motio	n.								
BI OOM'	S I FV/F	OF THE	COLIEG	SE OLIT	OMES										
2200W		11111		22 3310	-014163		BI	oom's	Level	\rightarrow					
со		Remem	ber	Unde	rstand		Apply		Anal	lyze	Εν	/aluate		Crea	ate
		(L1)		\ (L	2)		(L3)		(L	4)	/ `	(L5)		(Le	5)
CO1			\wedge	\longrightarrow ,	// \\		\rightarrow /			> /					
CO2				<u> </u>			1			<u>'/</u>					
CO3							√			<u>' / </u>					
CO4					/\		√ ✓					/_			
COURSE	ARTIC	JLATION	MATE	RIX					1				I		1
CO/ Po	s									0	1	2	_	7	
	001	P02	P03	P04	PO5	90	P07	808	60g	P01	P01	P01	PSO	PSO	PSO
	3	2							/				1		
CO1	3	3											1	3	
CO1		3											1	3	
CO1 CO2 CO3	3			1		<							1	3	
CO1 CO2 CO3 CO4	3	1							1				1	3	
CO1 CO2 CO3 CO4 Average	3 3 2 3	2.3 Medium	3_Hic	ار h					•						
CO1 CO2 CO3 CO4 Average Note: 1-l	3 3 e 3 ow, 2-	2.3 Medium	, 3-Hig	<u> </u> gh											
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CO1 CO2 CO3 CO4 Average Note: 1-L COURSE THEORY	3 3 2 3 .ow, 2-	2.3 Medium	, 3-Hig	th ;h		. Ui	nit-1	1							
CO1 CO2 CO3 CO4 Average Note: 1-l COURSE THEORY	3 3 9 3 ow, 2- CONTE	2.3 Medium	, 3-Hig	 gh chanics,	Idealiza	U i ation (nit-1 of bodi	es, Bas	ics con	cepts, f	⁻ undan	nental p	princiț	oles, sy	stem o
CO1 CO2 CO3 CO4 Averag Note: 1-l COURSE THEORY Introductunits. Concurre	3 3 3 Ow, 2- CONTE	2.3 Medium NT ngineerin	, 3-Hig	chanics,	Idealiza	Ui ation (nit-1 of bodi	es, Bas	ics con	cepts, f	^f undan orces	nental į	princip	oles, sy	stem o
CO1 CO2 CO3 CO4 Average Note: 1-le COURSE THEORY Introduct units. Concurre of couple	3 3 3 Ow, 2- CONTE	2.3 Medium INT Ingineering Ites in a poole	, 3-High	chanics, Concep n force	Idealization of force	U i ation (ce, vec	nit-1 of bodi	es, Bas arallelc	ics con	cepts, f aw of foces by	undan orces, metho	nental p Momer d of re	princip nt of f	oles, sy orce, N on, Nu	rstem o Momen
CO1 CO2 CO3 CO4 Average Note: 1-l COURSE THEORY Introduct units. Concurre of couple Problems	3 3 3 Ow, 2- CONTE	2.3 Medium INT Ingineering Les in a poole proble	, 3-Hig ng Med blane: ems o	chanics, Concep n force	Idealize t of fore	Ui ation o ce, veo puple,	nit-1 of bodi ctor, Pa	es, Bas arallelo osition	ics con gram I of forc	cepts, 1 aw of f ces by	fundan orces, metho	nental p Momer d of re	princip nt of f	oles, sy orce, N on, Nu	rstem o ∕lomen ımerica
CO1 CO2 CO3 CO4 Average Note: 1-le COURSE THEORY Introduct units. Concurre of couple Problems	3 3 ow, 2- CONTE	2.3 Medium INT Ingineering Ses in a poole proble	, 3-Hig ng Med olane: ems o	chanics, Concep n force	Idealization of fore	Ui ation o ce, veo puple,	nit-1 of bodi ctor, Pa Comp	es, Bas arallelo osition	ics con gram I of forc	cepts, f aw of f ces by	rundan orces, metho	nental p Momer d of re	princip nt of f	oles, sy orce, N on, Nu	stem o Aomen Imerica
CO1 CO2 CO3 CO4 Average Note: 1-l COURSE THEORY Introduct units. Concurre of couple	3 3 a 3 cow, 2- contention: E	2.3 Medium INT Ingineering Ses in a policy in the problem in th	, 3-Hig ng Med blane: ems o	chanics, Concep n force	Idealize t of fore and co	U i ation o ce, veo ouple,	nit-1 of bodi ctor, Pa Compo	es, Bas arallelo osition	ics con gram I of forc	cepts, f aw of f ces by	fundan orces, metho	nental p Momer d of re	princip nt of f	oles, sy orce, M on, Nu	rstem o Momen Imerica
CO1 CO2 CO3 CO4 Average Note: 1-le COURSE THEORY Introduce units. Concurre of couple Problems	3 3 ow, 2- CONTE	2.3 Medium INT Ingineering Ces in a policy le proble	, 3-Hig ng Med blane: ems o	chanics, Concep n force	Idealization of force	Ui ation o ce, veo puple,	nit-1 of bodi ctor, Pa Comp	es, Bas arallelo osition	ics con gram I of forc	cepts, f aw of f ces by	orces, metho	nental p Momer d of re	princip nt of f	oles, sy orce, N on, Nu	stem o Aomen Imerica
limitation course is COURSE This course applying COURSE After the CO CO1 CO2 CO3 CO4 COURSE CO/ Po CO1 CO2 CO3 CO4 Average Note: 1-L COURSE THEORY Introduction course of couple Problems Ref: Bos/s	3 3 a 3 cow, 2- conte	2.3 Medium INT regineering ces in a police proble	, 3-Hig ng Med blane: ems o	chanics, Concep n force	Idealization of force	Ui ation o ce, veo ouple,	nit-1 of bodi ctor, Pa Compa	es, Bas aralleld osition	ics con gram I of ford	cepts, f aw of f ces by	fundan orces, metho	nental p Momer d of re	princip nt of f	oles, sy orce, N on, Nu	stem o Momen merica

	Bloom's Level												
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)							
CO1		1											
CO2			1/	\1 /									
CO3			/ 1/ ^	// //									
CO4		//	V										

CO/ Pos	PO1	PO2	PO3	P04	POS	90d	P07	P08	P09	PO10	P011	PO12	PSO1	PSO2	PSO3
CO1	3	2		Ì			/ <		/				1		
CO2	3	3											1	3	
CO3	3	3											1	3	
CO4	3	1				<							1	3	
Average	3	2.3											1	3	

Unit-2

Non-Concurrent forces in a plane: Varignon's principle moments, resultants of non-concurrent force system, Numerical problems. Equilibrium of Concurrent forces in a plane Types of forces acing on the body, free body diagram, Equation of Equilibrium, Lami's theorem, equilibrium of connected bodies, Numerical problems.

Equilibrium of Non Concurrent forces in a plane: Equilibrium equation and Numerical Problems.

Unit-3

Centroid: Centre of gravity, center of gravity of a body, concept of centroid, centroid of two dimensional body, Determination of centroid or center of Gravity – integration method. Centroid of a composite plane figure.

Moment of Inertia: Moment of inertia of plane figure, polar moment of Inertia, radius of gyration, theorems of moment of Inertia, finding moment of inertia for standard sections.

Unit-4

Supporting Reaction: Types of support, Types of Beams, Types of loading, finding support reactions.

Introduction to Simples trusses: Types of Frames and its applications, Assumptions, Nature of forces in members. Numerical on pin joint stresses only

Friction: Introduction, law of friction, block resting on horizontal and inclined plane, Application of wedge and ladder, Rope and pulley systems.

TEXT BOOK

1. Ferdinand P. Beer, E. Russell Johnston, Jr. David F. Mazurek, Phillip J. Cornwell, with the collaboration of Brian P. Self, "Vector Mechanics for Engineers static and Dynamics", Tata McGraw Hill, 12th Edition.

REFERENCE BOOKS

1. Shames. I. H, and Krishna Mohana Rao.G, "Engineering Mechanics (Statics and Dynamics)", Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2006.

2. Hibbeler. R.C., "Engineering Mechanics: Statics & Dynamics", Pearson Education (US), 14th Edition, 2015.

JOURNALS/MAGAZINES

- 1. https://ascelibrary.org/journal/jenmdt
- 2. https://www.scimagojr.com/journalsearch.php?q=22062&tip=sid

SWAYAM/NPTEL/MOOCs:

- 1. https://swayam.gov.in/explorer?searchText=Engineering%20mechanics
- 2. https://nptel.ac.in/downloads/111104026/
- 3. https://www.coursera.org/learn/engineering-mechanic

Course Title	E	ntrepreneur	ship		Cours	е Туре	Hard Core		
Course Code	B20ME0104	Credits	1		CI	ass	I semester		
	TLP	Credits	Contact Hours	Work Load		umber of isses	Assessment in		
Course	Theory	1	1	1	Per Se	emester	vveig	ghtage	
Structure	Practice	0	0	0	Theory	Practical	IA	SEE	
	Tutorial	0	0	0	Theory	Fiactical	IA	SEE	
	Total	1	1	1	13	0	50 %	50 %	

COURSE OVERVIEW

This introductory course is designed to introduce you to the foundational concepts of entrepreneurship, including the definition of entrepreneurship, the profile of the entrepreneur, the role of venture creation in society. The course also provides a bird's eye view on the steps to start a venture, financing, marketing as well as support by various institutions towards entrepreneurship.

COURSE OBJECTIVES

- 1. To understand the basic terms, concepts in Entrepreneurship Development
- 2. To analyze and apply for the supporting schemes towards entrepreneurship

COURSE OUTCOMES (Cos)

со	Course Outcomes	Pos	PSOs
CO1	Understand and explain the key terms, definitions, and concepts used	6-12	3
	in Entrepreneurship Development	0 12	,
	Plan a start up by applying the knowledge of sources of finance and the		
CO2	supporting schemes offered by state and central governments and	2, 3, 6-12	3
	other entrepreneurial development organizations		

		Bloom's Level											
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)							
CO1	V	V											
CO2	√	√	√										

After the completion of the course, the student will be able to: CO	CO	npletic	on of th	e cours	e, the s	tudent irse Oii	tcomes	able to:				D,	os	PSC)s	
In Entrepreneurship Development	604	Under	stand a	nd exp	lain the	key te	rms, de	finitions	s, and c	oncept	s used		42	1 30	,,,	
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COURSE ARTICULATION MATRIX CO / Pos		(1	L1)		(L2)		(L3)		(L	4)		(L5)		(L6)		
CO/ Pos G	CO1		√		√		,									_
CO/ Pos	CO2	<u> </u>	√		√		√									
CO/Pos	COURSE ART	ICULA	TION N	/IATRIX							I	1	l			
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Average 1 3 1 1 1 1 1 1 1 3 1 Note: 1-Low, 2-Medium, 3-High COURSE CONTENT THEORY Unit-1 Introduction to Entrepreneurship: Evolution of term 'Entrepreneurship', Factors influencing entrepreneurship', Psychological factors, Social factors, Economic factors, Environmental factors. Characteristics of an entrepreneur, Difference between Entrepreneur and Entrepreneurship, Types of entrepreneurs. New generations of entrepreneurship viz. social entrepreneurship, Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship etc., Barriers to entrepreneurship, Creativity and entrepreneurship, Innovation and inventions, Skills of an entrepreneur, Decision making and Problem Solving. Unit-2 Institutional Support for Entrepreneurship: Organization Assistance to an entrepreneur, New Ventures, Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) license, Environmental Clearance, National Small Industries Corporation (NSIC), e-tender process, Excise exemptions and concession, Exemption from income tax, The Small Industries Development Bank of India(SIDBI), Incentives for entrepreneurs TEXT BOOKS 1. K. Ramachandran, "Entrepreneurship Development", Tata Mc. Graw Hill, 2008 2. Sangeeta Sharma, "Entrepreneurship Development" PHI Publications, 2016 REFERENCE BOOKS 1. Baringer and Ireland, "Entrepreneurship", Pearson, 11 th Edition, 2020. 2. P. Narayana Reddy, "Entrepreneurship – Text and Cases, Cengage Learning India", 1st Edition, 2010 3. Corporate Entrepreneurship: Building The Entrepreneurial Organization" by Paul Burns published by Palgrave Macmillan.	CO1	1					1	1	<u></u>	1	1	2	1			1
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Course Title	IoT and	Application	s		Course	е Туре	Har	d Core
Course Code	B20EC0101	Credits	2		Cla	iss	I Ser	nester
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	Theory	1	1	1	Per S	Semester	We	ightage
	Practice	1	2	2				
Course	Tutorial	0	0	0	Theory	Practical	IA	SEE
Structure	Total 2 3 3		>3	13	26	50 %	50 %	

СО	Course Outcomes	Pos	PSOs
CO1	Describe the architecture of IoT eco-system	1	1,2
CO2	Identify IoT devices, architecture, sensors and Communication protocols	1	1,2
CO3	Demonstrate the interface of sensors to IoT board	1,5, 12	1,2
CO4	Realize various Applications of IoT through case studies	1,5, 12	1,2
CO5	Develop simple IoT projects and modules	1,5,9, 12	1,2

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1 Intern	ational Sm	ZINES all Business	· lournal: https:	//iournals s	aganuh d	com/home	/ich		
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with In	board to b	uild lot pro	iects to solve s	s on session	s indt in	the case st	idy of dools	ypes senso	oT in variou
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COURSE	OBJECTIVI	ES							
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CO/ Pos	PO1	P02	PO3	PO4	PO5	90d	P07	PO8	60d	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3												3	3	
CO2	3												3	3	
CO3	3				3							3	2	2	
CO4	3				3							3	1	1	
CO5	3				3				2			3	3	3	
Average	3				3				2			3	2.4	2.4	

COURSE CO/ Po	ARTICUL	ATION	WIA I K	4 IV	2	9	7	∞	6	10	11	12	01	02	03
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CO1	3												3	3	
CO3	3				3							3	2	2	
CO4	3				3							3	1	1	
CO5	3				3				2			3	3	3	
Averag	e 3	dium	2 Liah		3				2			3	2.4	2.4	
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5.	connected to Arduino Board	IDE, Temperature	sensor to IoT board for
		sensor, Multimeter	temperature measurement
			application
	Reading motion detector sensor	Arduino UNO , Arduino	Interface of Motion
6.	value connected to IoT board	IDE, pyro-dielectric	detector sensor to IoT board
		sensor, Multimeter	for motion detection.
	Reading distance measurement	Arduino UNO, Arduino	Interface of Motion
7	using Ultrasonic sensor Connected to	IDE, Ultrasonic sensor,	detector sensor to
'	IoT board	Multimeter.	IoT board for
			motion detection
	Interface relay to IoT board	Arduino UNO , Arduino	Interface relay to
8		IDE, relay Multimeter	IoT board for Switching
			applications
	Connect Wifi-ESP8266 to Arduino	Arduino UNO	Connect IoT board to
9	UNO board, Send and receive data	ESP8266, Arduino IDE	
9	through smart phone.	Smart phone	Wifi network

SI. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	PART	C (Mini Project)	
	Arduino Controlled Light intensity:	ArduinoUNO,DS3231 RTC	Design and Implementation of
	design and build a simple , effective	Module, LDR 16×2 LCD	IoT project to solve Engineering
	circuit called Auto Intensity Control	Display ,LED,10KΩ	Problems.
1	of Street Lights using Arduino	Potentiometer,10KΩ	
1		Resistor, Push Button,	
		Connecting Wires,	
		Breadboard	
2	Thermometer: build an LCD	Arduino Uno,	Design and Implementation of
	thermometer with an Arduino	Temperature Sensor, LCD	IoT project for Engineering

	d a LM35/36 ure sensor.	analog	display, B Connectir		d and	application	ns.	
i comporaci	are sensor.		Comiccin	ib wires				
	ctivated light lam	-	Arduino U			Design and	-	
	on and off when		connectir generic.			application	_	cernig
	motion senso	r trash	Arduino U			Design and	•	
4 can: bui		motion	sensor, M motor, Br Connectir	eadboard		IoT project application	•	eering
ТЕХТ ВООК								
1. Vijay Madisetti, A		Internet of	Things: A	Hands-Or	n- Approac	ch " Secon	d edition 2	2014, ISBN:
978 099602551 REFERENCE BOOK	5.							
2. Raj Kamal," Interr	_	hitecture &	design Pr	inciple", N	McGraw H	ill Educatio	n, 2017.	
SWAYAM/NPTEL/N								
1. https://www.cou 2. https://www.cou			th-arduinc					
SELF-LEARNING EXE	_							
a) Create Ardı	uino project hub							
Course Title	Computer /	Vided Engin	eering Dr	wing	Cours	a Type	Harr	l Core
Course Code	B20ME0101	Credits		3	Cl	ass	I Ser	nester
	TLP	Credits	Contact Hours	Work Load	Total N Cla	umber of sses	Assess	ment in
Course	Theory	2	2	2	Per Se	mester	VVCIE	Sittage
Structure	Practice	0	2/ {	0	Theory	Practical	IA	SEE
	Total	3	4	4	26	26	50 %	50 %
COURSE OVERVIEW								
Engineering Graphic the conversion of ne	s or drawing is K w ideas and des	nown as ia gn concept	nguage of s into the	engineer: basic line	s. All pnas language	es of engin of graphics	eering pro . There are	cess require many area
such as civil, mech	anical, electrical	, architectı	ural, comp	uter, ele	ctronics a	nd industr	ial applica	tions where
knowledge and skil	ls of the drawin	g play maj	or roles in	n the des	ign and c	levelopmer	nt of new	products o
	ourse emphasizes	on project	ion of poin	it, line, su	rfaces and	l solids. It al	so provide	s knowledge
construction. This co	rne object in tern S	iis oi su vie	w and also	develop	ineni oi ti	ie object.		
construction. This coabout representing to COURSE OBJECTIVE	•	ous concep	ts like dim	ensioning	g, convent	ions and sta	andards of	engineering
construction. This co about representing to COURSE OBJECTIVE: 1. To introduce the	e students to vari		efficient					
construction. This co about representing to COURSE OBJECTIVE: 1. To introduce the drawings in ord	e students to vari er to become pro	ofessionally			anainaari	na drawina	ς	
construction. This co about representing to COURSE OBJECTIVE: 1. To introduce the drawings in ord 2. To enable stude	e students to vari er to become pro ints to learn abou	ofessionally ut the softw	vare tool to	o prepare	engineen	ing urawing		
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construction. This co about representing to COURSE OBJECTIVE: 1. To introduce the drawings in ord: 2. To enable stude 3. To teach the stu- surfaces and isc 4. To communicat	e students to vari er to become pro ents to learn abou dents about the metric projection e the concept/ide	ofessionally ut the softw concepts ar n of simple ea with oth	vare tool to nd principle solids ers throug	o prepare es of ortho h the lang	ographic p	rojections,	developm	ent of latera
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Course Title	Computer A	ided Engin	eering Dr	awing	Cours	е Туре	Hard	d Core				
Course Code	B20ME0101	Credits		3		3		3 Class		Class		nester
	TLP	Credits	Contact Hours	Work Load	Classes		sment in ghtage					
Course	Theory	2	/ 2 /	2	Per Se	mester	VVCI	Siitage				
Structure	Practice	1	2/	2	Theory	Practical	IA	SEE				
	Tutorial	0	0	0	rneory Practical		IA.	JLL				
	Total	3 🗸	4	4	26	26	50 %	50 %				

After the completion of the course, the student will be able to: CO Course Outcomes CO1 Draw orthographic projection of point, line manually and also by using CAD software. CO2 Draw orthographic projection of plane surfaces manually and also by using CAD software. CO3 CAD software. CO3 Draw orthographic projection of simple solids manually and also by using CAD software. CO4 Draw sectional views and development diagram of prisms, pyramids, cone and cylinder manually and also by using CAD software. CO5 Create isometric view of the solids manually and also by using CAD software. CO6 Create isometric view of the solids manually and also by using CAD software. CO7 Remember Understand Apply Analyze Evaluate (L6) CO8 Remember Understand Apply Analyze Evaluate (L6) CO9 V V V V V V V V V V V V V V V V V V V	After the co	mple	tion of	the co	urse, tl	he stud	ent wi	ill be ab	ole to:						1
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CO2 Draw orthographic projection of plane surfaces manually and also by using CAD software. CO3 Draw orthographic projection of simple solids manually and also by using CAD software. CO4 Draw sectional views and development diagram of prisms, pyramids, cone and cylinder manually and also by using CAD software. CO5 Create isometric view of the solids manually and also by using CAD software. CO6 Software. CO7 Software. CO8 Remember Understand Apply Analyze Evaluate (L1) (L2) (L3) (L4) (L5) (L6) (L6) (L6) (L6) (L6) (L6) (L6) (L6	CO1	soft	w orth ware.	ograpn	iic proj	ection c	τ poin	it, line	manua	ily and	aiso by	using	CAD	1,2,5,10	1
CO3 CO4 CO5 CO5 CO4 CO5	CO2	Drav	w orth	ograph	ic proj	ection c	of plan	e surfa	ces m	anually	and als	so by u	sing	1,2,5, 10	1
CO3 CAD software. CO4 Draw sectional views and development diagram of prisms, pyramids, cone and cylinder manually and also by using CAD software. CO5 Create isometric view of the solids manually and also by using CAD software. CO6 Remember Understand Apply Analyze Evaluate (L6) CO7 CO8 (L1) (L2) (L3) (L4) (L5) (L5) (L6) CO9 CO9 V V CO9 CO9 V V CO9		Drav	w orth	are. ograph	ic proi	ection c	of sim	ole soli	ds mar	ually ar	nd also	by usi	าย		
CO4 Draw sectional views and development diagram of prisms, pyramids, cone and cylinder manually and also by using CAD software. CO5 Create isometric view of the solids manually and also by using CAD software. CO6 Remember Understand Apply Analyze Evaluate (LG) (LG) (LG) (LG) (LG) (LG) (LG) (LG)	CO3	CAD	softw	are.	6. 0,		,, ,,,,,	310 3011	us 111u1	idany ai		. y us	.8	1,2,5, 10	1
CO Create isometric view of the solids manually and also by using CAD software. CO Co Co Co Co Co Co Co	CO4	Drav	w secti	onal vi er mar	iews an	id devel	opme by usi	nt diag	ram o	prisms	, pyrar	nids, co	one	1,2,5, 10	1
Bloom's Level CO Remember Understand Apply Analyze Evaluate Create (L1) (L2) (L3) (L4) (L5) (L5) (L6) CO1	CO5	Crea	ate iso	metric	view o	f the so	lids m	anually	and a	lso by u	ising C	AD.		1,2,3,5,10) 1
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CO Remember (L1) (L2) (L3) (L4) Evaluate (L5) (L6) CO1	PEOOINI 3 E	LVELC	, IHE	COUR	JL 001	COIVIES	•	D	nom's	Level					
(L1) (L2) (L3) (L4) (L5) (L6) CO1	20	R	emem	ber	Unde	erstand	Τ.	Naga A	oom s	Anal	vze	Ev	/aluate	С	reate
CO1	CO		(L1)		(L2)		(L3)		(L4	4)		(L5)		(L6)
CO2 CO3 CO4 CO5 CO4 CO5 CO4 CO5 CO4 CO5 CO4 CO5 CO6 CO6 CO7 CO8 CO7 CO8 CO7 CO8 CO7 CO8	CO1							V		^	\				
CO / POS	CO2					/		/							
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Orthographic projection of regular solids like prisms, pyramids cone and cylinder when the axis is inclined to both HP and VP. Unit-3 Sections of solids: Drawing sectional views and true shape of section, Development of surfaces- Parallel line nethod for prisms and cylinders, Radial line method for pyramids and cones.	surface is in	iclined	to bo	th HP a	and VP.			l lmia	•						
Unit-3 Gections of solids: Drawing sectional views and true shape of section, Development of surfaces- Parallel line method for prisms and cylinders, Radial line method for pyramids and cones.	Orthograph	ic nro	jection	of re	gular s	olids lik	e nric	onit: ms_nv	- z ramido	cone a	ınd cyli	inder w	/hen th	ne axis is i	nclined t
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			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			V			
CO2			N			
CO3			V \			
CO4	\wedge			V		
CO5				V		

							/ <			/ (
CO / POs	P01	P02	E0 4	P04	P05	P06	20 d	80d	60d	PO10	1109	P012	PSO1	PS02	PSO3
CO1	3	1			2					3			3		
CO2	3	2			2		>			3			3		
CO3	3	2			2		/ <			/ 3			3		
CO4	3	2			2	/				3			3		
CO5	3	2	2		2					3			3		
Average	3	1.8	2		2	<				3			3		

	1116 4		
lsom PRA	etric projections of simple and combined solids. CTICE: Practice Use of solid edge software and familiarization of tools Draw the projection of point locating in first and third quadrant Draw the projection of lines locating in first quadrant Draw the projection of rectangular and pentagonal lamina inclined to both HP and VP Draw the projection of prisms inclined to both HP and VP Draw the projection of prisms inclined to both HP and VP Draw the projection of pyramids inclined to both HP and VP Draw the projection of cone and cylinder inclined to both HP and VP Draw the projection of section of solids in simple position		
SI.	Practice	Tools and Techniques	Expected Skill /Ability
1.	Use of solid edge software and familiarization of tools	Solid Edge Software	Use of commands to draw the drawings
2.	Draw the projection of point locating in first and third quadrant	Solid Edge Software	Analyzing and software skill
3.	Draw the projection of lines locating in first quadrant	Solid Edge Software	Draw the views of the line and software skill
4.	Draw the projection of rectangular and pentagonal lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
5.	Draw the projection of hexagonal and circular lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
6.	Draw the projection of prisms inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
7.	Draw the projection of pyramids inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
8.	Draw the projection of cone and cylinder inclined to both HP and VP	Solid Edge Software	Interpretation and software skill
9	Draw the projection of section of solids in simple position	Solid Edge Software	Analyzing and Software Skill
10	Develop the lateral surface of prisms and cylinder	Solid Edge Software	Creative and Software Skill
11	Develop the lateral surface of pyramids and cone	Solid Edge Software	Creative and Software Skill
12	Draw the isometric projection of simple plane surface and simple solids	Solid Edge Software	Analyzing and software skill
13	Draw the isometric projection of two co-axial solids	Solid Edge Software	Analyzing and software skill
1. K : 2. K. 3. Bh REFE 1. Lu 2. Sh SWA 1. htt	R. Gopalakrishna, "Engineering Graphics", Subhas Publicat N.D., Panchal V.M. & Ingle P.R, "Engineering Drawing", RENCE BOOKS zadder and Duff, "Fundamental of Engineering Drawing", Fiah, M.B. and Rana B.C., "Engineering Drawing and Comput NYAM/NPTEL/MOOCS: tps://nptel.ac.in/courses/112/103/112103019/ ttps://www.udemy.com/course/ed/	ons, 2012. Charotar Publishir rintice Hall of India	ng House, 2014. a Pvt. Ltd. 11 th Edition, 2001.
Ref: E	OS/SME/BME-2020-21-20.06.20/2021-22-05.06.21/2022-23-25.06.22/20 59	023-24-10.06.23	

Course Title	Vector Ca		Partial Diffe uations	rential	Course	е Туре	FC	
Course Code	B20AS0205	ASO205 Credits 4				ass	II Semester	
	TLP	Credits	Contact Hours	Work Load	Classes		Assessm	
Course	Theory	3	3	3	Per Sei	mester	Weightage	
Structure	Practice	0	0	0	Theory	Tutorial	IA	SEE
	Tutorial	1	1	1	- Theory Tutorial		iA.	JLL
	Total	4	4	4	39	13	50 %	50 %

	Vector Ca	alculus and	2 nd Ser Partial Diff	nester erential	Cour	eo Tuno		EC
Course Title		Equ	ations		Cours	e iype		
Course Code	B20AS0205	Credits		4	С	ass	II Sei	mester
	Practice 0 0 0 Theory Tutorial 1 1 1 1 Total 4 4 4 39 VERVIEW e is an essential one for civil and mechanical engineering students are a erential equations and methods of solving them. BJECTIVE e enables graduating students to identify mathematical requirements are a graphications to civil and mechanical engineering problems. Course Outcomes Apply partial derivatives to calculate rates of change of multivariate functions. Analyze motion problems from real lines to curves and surfaces in 3-D. such as directional derivatives, divergence and curl of vector and graciplay significant roles in many applications. Interpreting line and multiple vector integral and its applications to evaluations to evaluations to evaluations and multiple vector integral and its applications to evaluations.							sment in ghtage
Course	Theory	3	3	3	Per Se	emester		
Structure	Practice	0	0	0	Theory	Tutorial	IA	SEE
	Tutorial	1	1	1				
COURSE OVER WEST	Total	4	4	4	39	13	50 %	50 %
This course enables developing applicati COURSE OUTCOME After the completion	graduating sto ons to civil and (S (Cos): n of the cours	udents to id ad mechanic	entify math	nematical in problems in the p	equirements ms.	s and to find	efficient	solutions i
СО	4:al /1- :	Cour	se Outcom	es\			Pos	PSOs
CO1 Apply par functions	tíal derivative	es to calcula	ite rates of	change of	multivariate	Table	1, 2,	1
CO2 such as d	irectional der	rivatives, di manyanni	vergence a	nd curl of	vector and g	radient	1, 2	1
piay signi	lay significant roles in many applications. nterpreting line and multiple vector integral and its applications to evaluate							
CO3 Interpreti multiple i	ing line and m	ultiple vect	or integral a	and its app	ications to e	valuate	1, 2	1
CO3 Interpreti multiple i Implemer more that equations studies ar	ing line and m ntegrals invol nting Mather an one inder s. They also and the analysi	ultiple vectiving physic matical moderndent varies in such s of econom	or integral a al phenome dels of phenome riable ofte diverse are nics.	enon. ysical phe n include a as epide	nomenon ir partial diffi	valuate volving erential fic flow	1, 2	1
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CO3 Interpreti multiple i Implemer more that equations studies ar BLOOM'S LEVEL OF CO CO1 CO2	ing line and metegrals involuting Mather an one indepose. They also and the analysis THE COURSE	ultiple vectoring physic matical morporate in such sof economic outcomes ou	or integral a phenome dels of phenome diverse are nics. Appl (L3)	enon. ysical phe n include a as epide Bloom's Le	nomenon ir partial diff miology, traf vel Analyze (L4)	valuate volving erential fic flow Evaluate (L5)	1, 2	1 1 Create (L6)
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		Bloom's Level											
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)							
CO1	√	√	$\sqrt{}$		V								
CO2		√	$\sqrt{}$		V								
CO3	√	√	$\sqrt{}$		V								
CO4		√	$\sqrt{}$		V								

CO / Pos	PO1	PO2	PO3	PO4	POS	P06	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											1		
CO2	3	2											1		
CO3	3	2											1		

CO4	3	2						1	
Average	3	2						1	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1:

Partial Derivatives and Multiple Integrals: Functions of several variables – Partial derivatives, Homogeneous Functions – Euler's theorem, Jacobians. Multiple Integrals – Double integrals – Change of order and change of variables. Triple integrals Illustrative examples for change of order and change of variables. Gamma and Beta functions with simple examples. Engineering applications.

Unit -2

Vector Calculus: Differentiation of Vectors, Curves in space, Velocity and Acceleration, Tangential and normal acceleration, Relative velocity and acceleration, Scalar and vector point functions- Vector operator del. Del applied to scalar point functions – Gradient, Del applied to Vector point function – Divergence and Curl. Engineering applications.

Unit -3

Vector integration: Line integral – Circulation – work, Surface integral – Flux, Green's Theorem in the Plane, Stokes Theorem, Volume Integral, Divergence Theorem, Green's Theorem, Irrotational and Solenoidal Fields, Orthogonal Curvilinear Coordinates. Engineering Applications.

∕Unit -4

Partial Differential Equations: Formation of partial differential equations, solutions of non-homogeneous PDE by direct integration, Solutions of homogeneous PDE involving derivatives with respect to one independent variable, solution of Lagrange's Linear PDE, Solutions of PDE by product method, Engineering Applications.

TEXT BOOKS

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Reprint edition, 2013.

2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2013.

REFERENCE BOOKS

- 1. P.V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning, 7th Edition, 2012.
- 2. Potter and Goldberg, "Mathematical Methods", Printice Hall of India Pvt. Ltd.

JOURNALS/MAGAZINES:

- 1. https://www.journals.elsevier.com/partial-differential-equations-in-applied-mathematics/
- 2. https://www.elsevier.com/books/vector-calculus/cox/978-0-08-057295-6

SWAYAM/NPTEL/MOOCs:

- 1. https://www.coursera.org/learn/calculus-and-optimization-for-machine-learning
- 2. https://www.coursera.org/learn/vector-calculus-engineers.
- 3. https://www.coursera.org/learn/differential-equations-engineers

Course Title		Applied Ch	nemistry		Cours	е Туре		FC
Course Code	B20AS0201	Credits	3		Cla	ass	II sei	nester
	TLP	Credits	Contact Hours	Work Load		umber of sses		ment in
Course	Theory	3	3	3	Per Se	mester	wei	ghtage
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	meory	Practical	iA	SEE
	Total	3	3	3	39	0	50 %	50 %

COURSE OVERVIEW

Applied chemistry covers very relevant topics compatible with Civil engineering students and make them aware of importance of various aspects of basic science in engineering. The subject of applied chemistry covers area of water technology, corrosion phenomenon, which is widely an interdisciplinary subject of discussion. Further the course focus on the corrosion phenomenon, and various methods to control it. This area of science is very much

СО	Course Outcomes	POs	PSOs
CO1	Describe properties of water and various methods employed in water treatment.	1	1
CO2	Explain the corrosion phenomenon and account for methods used in its control.	1	1
CO3	Categorize and explain construction and working of energy storage and conversion devices.	1, 2	1
CO4	Understand common use of metals and alloys, ceramics, polymers, their composition, properties and engineering applications.	1	1

			Bloom'	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
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CO4	✓					

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,	and stora	ge devi	ices	which	have	becom	ie ver	v attra	ctive fi	eld of	resear	ch in	engine	erings	tream	, The	subject
·	deals with	ı variou	ıs en	gineerii	ng ma	aterials	, their	prope	rties a	nd apn	licatio	ns in tl	he field	of eng	ineeri	ing.	
	COURSE	OBJECT	ΓIVES) }	۰۰۰۰ ی		,	,		- ~PP	, , , , , ,					ο.	
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	1. To impa	art kno	wled	lge abou	ut the	signifi	icance	of wat	er che	mistry	and va	rious	metho	ds of w	ater t	reatm	ent.
	2. To prov	ide info	orma	ation on	elec	troche	mical	concep	ts of co	rrosio	n scier	nce an	d engir	neering			
	3. Highligh	hts on e	ener	gy stora	ge de	evices a	and ot	her ren	ewabl	e ener	gy sou	rces ai	nd thei	r applic	ations	5.	
,	4. Introdu	iction to	o en	gineerir	ng ma	terials	, prop	erties a	ind the	ir appl	lication	ıs.					
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	CO2	Explai	in the	e corros	ion p	henom	nenon	and ac	count	or me	thods	used ii	n its co	ntrol.	1	L	1
	CO3	Catego	orize	and	expla	in cor	struct	tion a	nd wo	rking	of en	ergy	storag	e and	1	2	1
		conve	rsior	n device	s.		/		\ <u></u>								
	CO4	Under	rstan	d com	mon	use o	of me	tals ar	nd allo	ýs, ce	eramic	s, pol	ymers,	their	1	L	1
		compo	ositio	on, prop	ertie	s and e	engine	ering a	pplicat	ions.							
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COURSE CONTENT THEORY

Unit-1

Water Technology: Sources of water, Impurities of water, Hardness & its determination (EDTA method), Boiler Troubles & their removal, water softening methods -Lime soda, Zeolite & Ion exchange, Desalination of water — Electro dialysis & Reverse osmosis method, Chemical analysis of water

Unit-2

Corrosion: Definition, Examples, Types, Theory of corrosion, Dry corrosion (Direct chemical Attack), Wet corrosion (electrochemical attack), Mechanism of wet corrosion, Factors affecting corrosion, Corrosion Control methods, protective coatings — Metallic & organic type.

Unit-3

Energy devices: Batteries & types, fuel cell, super capacitors, photo voltaic cell.

l Init-4

Materials: Metals & Alloys: Classification and properties of iron, Steel, Nickel, Chromium, Tungsten & alloys. **Modern materials:** Classification, properties, and compositions: polymers, biomaterials, glass, cement, ceramics, composite materials, Nano materials, thin films, liquid crystals.

TEXT BOOKS

- 1. R.V.Gadag and Nithyanandashetty, "Engineering Chemistry", Ik International Publishing house.
- 2. S.S. Dara, "Text Book of Engineering Chemistry", S. Chand & Co.

REFERENCE BOOKS

- 1. P.W. Atkins, "Physical Chemistry", Oxford Publisher, 5thedition.
- 2. Callister W.D., "Materials Science and Engineering", John Wiley & Sons.

JOURNALS/MAGAZINÉS:

- 1. https://www.sciencedirect.com/journal/water-science-and-technology
- 2. https://iwaponline.com/wst
- 3. https://www.scitechnol.com/nanomaterials-molecular-nanotechnology.php
- 4. https://www.journals.elsevier.com/journal-of-energy-storage

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/105/105/105105201/
- 2. https://nptel.ac.in/courses/112/108/112108150/

Course Title	Introduc	tion to Pyth	on Programm	ning	Cour	se Type	Hard	d Core
Course Code	B20Cl0101	Credits	3		C	lass	II Se	mester
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in ghtage
Course	Theory	2	2	2	Per Se	emester	VVEI	giitage
Structure	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0	Theory	Tractical	IA.	JLL
	Total	3	4	4	26	26	50 %	50 %

COURSE OVERVIEW

Python is a Programming Language that can be treated in a procedural way, an object-orientated way or a functional way. It can be used on a server to create web applications, create workflows, connect to database systems, read and modify files, handle big data and perform complex mathematics. It can implement object oriented features and exception handling, It can parse the strings using regular expressions. It can be used for implementing the machine learning algorithms to develop solutions for interdisciplinary problems apart from any general problems leading to automation.

COURSE OBJECTIVES

The objectives of this course are to:

1. Explain the fundamentals of python programming language constructs and their applications.

2. Inculcate 3. Gain exp 4. Discuss t COURSE OR After the co CO CO1 CO2 CO3 CO4 BLOOM'S L CO CO1 CO2 CO3 CO4 CO4 CO4 CO4 CO4 CO7 CO4 CO7	knowl	edge (of pars	ing of i	egular	expre	ssions	and the	eir usag	e in va	rious a	pplicat	tion do	mains.	
3. Gain exp	ertise ii ha filas	n Obje	ect orie	ented p	rogram	ıming zation	and Nu	ımPy p ots	ackage.	•					
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СО					Cours	e Outo	comes						POs		PSOs
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CO3	Apply for	eature ationa	es of ally inte	object ensive a	orien applica	ted a tions t	nd Nu o analy	mPy /ze and	oackage Linterp	e to d ret the	evelop data.	1 to	5, 9, 1	12	2
CO4	Create /isualiza	data s ation.	science	solut	ions wi	ith the	e help	of file	s, Pano	das an	d Data	1,4	1,5,9,1	2	1
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CO2	3	2	3	1	2				1			1		3	
CO3	3	1	2	1 /	2		Ť		1			1	2	2	3
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Checking fo	r Hund	lreds,	Using 1	the {n,	m} Syn	tax, Ch	necking	for Te	ns and	Ones.					
							Unit	-3							

		/	Bloom	's Level		
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			/ /			
CO2						
CO3	\wedge		V	V	\wedge	
CO4			V	V	V	٧

CO/ POs	P01	20 d	P03	P04	50 d	90e	P07	80a	PÔ9	PO10	1104	210d	LOSA	PS02	PSO3
CO1	3	1	1	2				1	1			1	3		
CO2	3	2	3		2			\wedge	1			1		3	
CO3	3	1	2	1 /	2				1			1			3
CO4	3			2	2		>	/	1>			1	3	3	3
Average	3	1.3	2	1.7	2			1	/1			1	3	3	3

Obje Absti Files:	ct Oriented Programming: Defining Classes, The init () Met raction. Encapsulation, Single Inheritance, Polymorphism. Reading from Text Files, Writing to text files, Reading and Writ	hod, Instantiating ing the Binary Files	Classes, OOP features
Num Array Pand	py: Introduction to numpy, Creating arrays, Indexing Arrays, Arr Processing, Array Input and Output. las and Data Visualization: Introduction, Series and Data Frame	ay Transposition, Us	Iniversal Array Function
PRAC	CTICE:		
SI.No	Title of the Experiment	Tools and	Expected Skill
	Part-A	recilliques	Ability
	a). "LIST1" is a list that contains "N" different SRN of students read using a user defined function with the help of input () function. It is required to add SRN of "M" more students that are to be appended or inserted into "LIST1" at the appropriate place. The program must return the index of the SRN entered by user	Windows/Linux OS, IDE, Jupyter	Create and perform operations on list.
1.	ct Oriented Programming: Defining Classes, The init () Met raction. Encapsulation, Single Inheritance, Polymorphism. Reading from Text Files, Writing to text files, Reading and Writ Unit-4 py: Introduction to numpy, Creating arrays, Indexing Arrays, Array Processing, Array Input and Output. las and Data Visualization: Introduction, Series and Data Frame Title of the Experiment Part-A a). "LIST1" is a list that contains "N" different SRN of students read using a user defined function with the help of input () function. It is required to add SRN of "M" more students that are to be appended or inserted into "LIST1" at the appropriate place. The program must return the index of the SRN entered by user. b). "TUPLE1" and "TUPLE2" are two tuples that contain "N" values of different data types read using the user defined function "READ" with the help of input() function. Elements of "TUPLE1" and "TUPLE2" are to be read one at a time and the "larger" value among them should be placed into "TUPLE3". Display all tuples. a).SET1 and SET2 are two sets that contain unique integers. SET3 is to be created by taking the union or intersection of SET1 and SET2 using the user defined function Operation (). Perform either union or intersection by reading choice from	Windows/Linux OS, IDE, Jupyter	Create and perform operations on Tuples.
2.	user. Do not use built in functions union () and intersection () and also the operators " " and "&".	Windows/Linux OS, IDE, Jupyter	
	b). The Dictionary "DICT1" contains N Elements and each element in dictionary has the operator as the KEY and operand's as VALUES. Perform the operations on operands using operators stored as keys. Display the results of all operations.		Create dictionary and perform operation using user defined function.
3.	 a).A substring "Substr" between index1 and index2 is to be extracted from the given input string "Str1", which is read using input (). Display the substring "Substr" using a user defined function if available in string "Str1", otherwise display NULL. b) A string containing multiple words is to be read from the user one at a time, after reading perform following operations. 	Windows/Linux OS, IDE, Jupyter	String operations.
	i) Convert all the strings to uppercase and displayii) Split the words of a string using space as the separation character and display.		

SI.No Title of the Experiment A. Read the file, "Std.txt" and display the details of all the students of 4" Semester "A" Section who have scored more than 75%. B), Consider the text file "Emp.txt", with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NET_SALARY, LICE, PF and TOTAL_DEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, DA, CLOON, EMP_NAME, AND CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input() and compute the following: 1) TOTAL_DEDUCTIONS- (IC-PF) 1) GROSS_SALARY BASIC_SALARY DA 1ii) NET_SALARY-GROSS_SALARY TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of "Emp.txt" and display the details of each employee. 2) A "CAR" has the attributes COMPANY_NAME, MODEL, employee. 3) A "CAR" has the attributes COMPANY_NAME, MODEL, employee. 3) A "CAR" has the attributes and perform the following operations: 1) Get the details of "CAR" object from user and store into Array of Objects. 2) D, Alrine Reservation System contains the attributes of passengers such as NAME, PAN_DO, MIR-FARE and TRAVEL_DATE. A class is required to be created for "Car" object from user and store into Array of objects. 3) Get the details of "arrine" object from user and store into Array of objects. 3) List details of all the passengers who travelled From "Bengaluru to London". 3) List details of all the passengers who travelled From "Chicago to Beijing" on 10" of Feb, 2020. 3) "Arr List is an integer array of size M is N. Size and content of the array is to be read using input () by using the user defined function READ_DATA (). It is required to display the 6 () Diagonal elements of "Tru" 1" 3) Elements of m" row (row no should be entered by user) 3) Elements of m" row (row no should be entered by user) 3) Elements of m" row (row no should be entered by user)	SI.No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
b).Consider the text file "Emp.txt", with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NAT_SALARY, LIC, PF and TOTAL-DEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input() and compute the following: i) TOTAL_DEDUCTIONS=(LIC+PF) ii) GROSS_SALARY=BASIC_SALARY+DA iii) NET_SALARY=GROSS_SALARY+TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of "Emp.txt" and display the details of each employee. a). A "CAR" has the attributes COMPANY_NAME, MODEL, COLOR, MANUFACUTING_YEAR and PRICE. A Class is required to be created for "CAR" to store the above attributes and perform the following operations: ii) Get the details of "CAR" object from user and store into Array of objects iii) Display the details of "CAR" object based on "COMPANY", "MODEL" and "PRICE". b). Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, 5. SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for "Airliline" with the above attributes and perform the following operations: ii) Get the details of "Airline" object from user and store into Array of objects iii) List details of all the passengers who travelled From "Bengaluru to London". iii) List details of all the passengers who travelled From "Bengaluru to London". iii) List details of all the passengers who travelled From "Bengaluru to London". iii) List details of all the passengers who travelled From "Chicago to Bejling" on 10% of Feb, 2020.	4.	Read the file, "Std.txt" and display the details of all the students of 4 th Semester "A" Section who have scored more than 75%.		
a). A "CAR" has the attributes COMPANY_NAME, MODEL, COLOR, MANUFACUTING_YEAR and PRICE. A Class is required to be created for "CAR" to store the above attributes and perform the following operations: i) Get the details of "CAR" object from user and store into Array of objects ii) Display the details of "CAR" object based on "COMPANY", "MODEL" and "PRICE". b). Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, 5. SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for "Airline" with the above attributes and perform the following operations: i) Get the details of "Airline" object from user and store into Array of objects ii) List details of all the passengers who travelled From "Bengaluru to London". iii) List details of all the passengers who travelled From "Chicago to Beijing" on 10 th of Feb, 2020.		b).Consider the text file "Emp.txt", with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NET_SALARY, LIC, PF and TOTAL-DEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input() and compute the following: i) TOTAL_DEDUCTIONS= (LIC+PF) ii) GROSS_SALARY= BASIC_SALARY+ DA iii) NET_SALARY= GROSS_SALARY - TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of "Emp.txt" and display the details of each employee.		File Handling.
color, Manufacuting_Year and Price. A class is required to be created for "CAR" to store the above attributes and perform the following operations: i) Get the details of "CAR" object from user and store into Array of objects ii) Display the details of "CAR" object based on "COMPANY", "Model" and "Price". b). Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, 5. SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for "Airline" with the above attributes and perform the following operations: i) Get the details of "Airline" object from user and store into Array of objects ii) List details of all the passengers who travelled From "Bengaluru to London". iii) List details of all the passengers who travelled From "Chicago to Beijing" on 10th of Feb, 2020. a) "Arr 1" is an integer array of size M x N. Size and content. Windows/Linux. NumPy arrays.		a). A "CAR" has the attributes COMPANY_NAME, MODEL,	Windows/Linux	Classes and
	5.	required to be created for "CAR" to store the above attributes and perform the following operations: i) Get the details of "CAR" object from user and store into Array of objects ii) Display the details of "CAR" object based on "COMPANY", "MODEL" and "PRICE". b). Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for "Airline" with the above attributes and perform the following operations: i) Get the details of "Airline" object from user and store into Array of objects ii) List details of all the passengers who travelled From "Bengaluru to London". iii) List details of all the passengers who travelled From "Chicago to Beijing" on 10 th of Feb, 2020.	Windows/Linux	NumPy arrays

b). The dictionary "DICT1" contains the pass percentage of each semester of B. Tech in CSE, where, " Semester" acts as the key and "Pass Percentage" acts as the value. A Python Pandas data frame is required to be created using the dictionary "DICT1" and display it using a user defined function. Part-B (Mini Project: Library Manage Develop a program to create the class "USER" with the attributes USER_NAME, USER_ID, SCHOOL_NAME, ADDRESS, PHONE_NO, EMAIL_ID, DOB and AGE. The functions add_user (), delete user (), edit user (), search user () should be part of the class. Instantiate "User" class with 10 objects. Read the attributes of each "User" object using input () and store them in the file "User_File.txt". Develop a program to get the name of the "User" object whose details are to be deleted. Read the "User_File.txt" and delete the "User" object if found. Display the contents of "User_File.txt" after deletion. Develop a program to get the name of the "User" object whose details are to be edited (modified). Edit the details of the user object in the file "User_File.txt" and display the contents after modification. Develop a program to create the class "BOOK" with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, SCHOOL_NAME and the functions add book(), delete book(),		Pandas Series
each semester of B. Tech in CSE, where, "Semester" acts as the key and "Pass Percentage" acts as the value. A Python Pandas data frame is required to be created using the dictionary "DICT1" and display it using a user defined function. Part-B (Mini Project: Library Management of the control of the contro		usability.
Pandas data frame is required to be created using the dictionary "DICT1" and display it using a user defined function. Part-B (Mini Project: Library Management)		
dictionary "DICT1" and display it using a user defined function. Part-B (Mini Project: Library Management of the content of t		
function. Part-B (Mini Project: Library Manag		
Part-B (Mini Project: Library Manag		
	rement System)	
Develop a program to create the class "USER" with the	Windows/Linux	Create a class user
attributes USER_NAME, USER_ID, SCHOOL_NAME, ADDRESS,	OS, IDE, Jupyter	to read the
PHONE_NO, EMAIL_ID, DOB and AGE. The functions add_		attributes of user
user (), delete user (), edit user (), search user () should be		and store them in a
part of the class. Instantiate "User" class with 10 objects.		file.
Read the attributes of each "User" object using input () and		
Develop a program to get the name of the "User" object	Windows/Linux	Create a class user
whose details are to be deleted. Read the "User_File.txt" and	OS. IDE. Jupyter	to read the
delete the "User" object if found. Display the contents of)	attributes and
"User_File.txt" after deletion.		delete the object.
Develop a program to get the name of the "User" object	Windows/Linux	To create a class
whose details are to be edited (modified). Edit the details of	OS, IDE, Jupyter	and edit the file.
the user object in the file "User_File.txt" and display the		
Contents after modification.	Windows/Linux	Create a class book
attributes TITLE ALITHOR PUBLISHER VEAR PRICE	OS IDE Junyter	to read the
SCHOOL NAME and the functions add book() delete book()	O3, IDE, Jupytei	attributes of user
edit book() and search book(). Instantiate "Book" class with		and store them in a
10 objects. Read the attributes of each "BOOK" object using		file.
input () and store them in the file "Book_File.txt".		
Develop a program to get the name of the "BOOK" object	Windows/Linux	Create a class book
whose details are to be deleted. Read the "Book_File.txt" and	OS, IDE, Jupyter	to read the
ontared Display the contents of "Rock File tyt" after		attributes and
deletion.		delete the object.
Develop a program to get the name of the "BOOK" object	Windows/Linux	To create a class
whose details are to be edited (modified). Edit the details of	OS, IDE, Jupyter	and edit the file.
the "Book" object in the file "Book_File.txt" and display the		
contents after modification.		
Develop a program to create the class "TRANSACTION" with	Windows/Linux	Create class and
the attributes USER_ID, USER_NAME, AUTHOR, TITLE,	OS, IDE, Jupyter	perform string
functions issue book(), return book() and search book().		operations.
7 Instantiate "Transaction" class with 10 objects. Read the		
attributes of each "Transaction" object using input () and		
store them in the file "TransactionFile.txt". Develop a		
program to issue the book as requested by the user. Update		
Develop a program to create the class "BOOK" with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, SCHOOL_NAME and the functions add book(), delete book(), edit book() and search book(). Instantiate "Book" class with 10 objects. Read the attributes of each "BOOK" object using input () and store them in the file "Book_File.txt". Develop a program to get the name of the "BOOK" object whose details are to be deleted. Read the "Book_File.txt" and delete the "BOOK" object whose details match with the data entered. Display the contents of "Book_File.txt" after deletion. Develop a program to get the name of the "BOOK" object whose details are to be edited (modified). Edit the details of the "Book" object in the file "Book_File.txt" and display the contents after modification. Develop a program to create the class "TRANSACTION" with the attributes USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE,DUE_DATE and RETURN_DATE and the functions issue book(), return book() and search book(). Instantiate "Transaction" class with 10 objects. Read the attributes of each "Transaction" object using input () and store them in the file "TransactionFile.txt". Develop a program to issue the book as requested by the user. Update	•	_

SI.No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	the attributes in "Transaction_File" and display the contents of file.	reamiques	/ Automoty
8	Develop a program to return the book. Edit the details of the user like USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE, DUE_DATE and RETURN_DATE in "TransactionFile.txt" and display the contents after modification. Compute the fine amount to be paid if return date is not same as due date. If both return date and due date are same and put zero in fine amount.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operation.
9	Develop a program to search for a book using its "author". Display the message "available" if search is successful otherwise display the message "not available".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
10	Develop a program to get a list of users by referring to "User_File.txt" and "Transaction_File.txt".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
11	Develop a program to get List of Books in stock by referring to "Book_File.txt" and "Transaction_File.txt".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
12	Develop a program to get List of Books Issued by referring to "User File", "Book File" and "Transaction File".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
13	Develop a project by integrating User, Books, Transaction and Reports Modules.	Windows/Linux OS, IDE, Jupyter	Module integration and project development.
1. Ma 22. Tra 22. Tra 11. A B 22. Ma 22. Ma 33. Joh 24. Mid 55. We 66. Ste 66. Ste 66. Ste 77. Ke 88. Joh 10 Htt 11. htt 11. htt 12. htt	ark Pilgrim, "Dive into Python 3", Apress Special Edition, 2nd Editivis E. Oliphant, "Guide to NumPy", Trelgol Publishers, 2006. RENCE BOOKS Choudhary, "Flowchart and Algorithms Basics", Mercury Learnark Lutz, "Learning Python", Oreilly, 2003. In M. Zelle, "PYTHON Programming: An Introduction to Comput 004. Chael Dawson, "Python Programming", Prentice Hall, 2nd Editive Holden and David Beazley, "Python Web Programming", New 11 D. Lee, "Python Programming Fundamentals", Springer, 2nd Editive Holden, "Introduction to Computation and Programming ups://www.tutorialspoint.com/computer fundamentals/comput NALS/MAGAZINES ps://www.codemag.com/Magazine/ByCategory/Python p://ijaerd.com/papers/special_papers/IT032.pdf ps://iopscience.iop.org/article/10.1088/1742-6596/423/1/0120 ps://ieeexplore.ieee.org/document/4160250	ing and Information ser Science", Frankles", CENAGE Learningtion. We Riders Publishers Edition. Sing Python", MIT Fater fundamentals	in, Beedle & Associatesing, 3 rd Edition. , 2002. Press, 2016.

Course Title	Basic Electri	ical and Elect	ronics Engine	Course	Туре	Hard Co	ore	
Course Code	B20EE0101	Credits	4		Class		II Sem	ester
	TLP	Credits	Contact Hours	Work Load		umber of sses		ment in
Carran	Theory	3	3	3	Per Semester		Weightage	
Course Structure	Practice	1	2	2				
Structure	Tutorial	0	0	0	Theory Hours	Practical Hours	IA	SEE
	Total	4	5	4	39	26	50 %	50 %

SWAYAM / NP	TEL / MOOCs:							
 Coursera – Py Coursera – Py https://nptel. 								

		Bloom's Level										
со	Remember	Understand	Apply	Analyze	Evaluate	Create						
	(L1)	(L2)	(L3)	(L4)	(L5)	(L6)						
CO1	٧	٧										
CO2				٧								

CO3		٧		
CO4			٧	
CO5		٧		
CO6			٧	

COURSE ARTICULATION MATRIX

CO / Pos	PO1	P02	PO3	PO4	PO5	90d	70 q	P08	60d	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	2	1											1		
CO2	1	1											1		
CO3	2	2								2			1		
CO4	3	1											1		
CO5	2	2							3	1			3	3	
CO6	2	2							3	1			3	3	
Average	2	1.5							3	1.3	·		1.7	3	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT THEORY

Unit-1

Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, Kirchhoff's Laws, Resistive, Inductive, capacitive networks, Series, Parallel circuits and Star-delta and delta-star transformations, Network Theorems (Superposition, Thevenin's & Norton's) Generation of an alternating Emf—average and rms values of alternating quantity—representation of alternating quantities by phasors—single phase series and parallel circuits (simple problems), three phase systems and power calculations.

Unit-2

DC-Machines: Construction and Principle of operation of DC Machines—Emf & Speed equations-types—applications. AC-Machines: Principle of operation of single phase transformers—Emf equation—losses—efficiency and regulation-Construction and working principle of induction motors—Slip—torque characteristics—applications-Construction and Principle of operation of alternators applications.

Unit-3

Instruments: Basic Principle of indicating instruments—PMMC&MI instruments. Tariff, Protective Devices and Sensors: Tariff schemes, basic concepts of domestic wiring and types, Earthing, protective fuses, MCB, sensors: pressure sensors, strain gage, proximity sensors, displacement sensors, Rotatory encoder and ultrasonic sensors and civil engineering applications.

Unit-4

Diodes: Introduction, Physical operation of p-n junction diodes, Characteristics of p-n junction diodes, Zener diode, Rectifier circuits (half-wave, full-wave, bridge and peak rectifiers), Light emitting diodes.

Digital Electronic Principles: Introduction, Binary digits, Logic levels and Digital waveforms, Introduction to basic logic operation, Number system, Decimal numbers, Binary numbers, Decimal-to-Binary conversion, Simple binary arithmetic.

PRACTICE:

SI.	Title of the Experiment	Tools and	Expected Skill
No	Title of the experiment	Techniques	/Ability
	Electrical Safety Training.		Importance &
	a) To Study the importance of Earthing during		applications of Earthing,
	accidental shorting of line wire and the body of		Fuse & MCB
	equipment.	Trainer kit	

8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Ohms Law Fall of resistance Fluorescent Lamp wiring Panel Fan with switch and regulator Kit Two-way switch or staircase wiring Kit Series and parallel circuits Kit Transformer Kit	Connection & Trouble shooting of Fluorescent lamp wiring & Fan with switch and regulator Connection, Working & application of Two-way switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Fall of resistance Fluorescent Lamp wiring Panel Fan with switch and regulator Kit Two-way switch or staircase wiring Kit Series and parallel circuits Kit Transformer Kit	Connection & Trouble shooting of Fluorescent lamp wiring & Fan with switch and regulator Connection, Working & application of Two-way switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Fluorescent Lamp wiring Panel Fan with switch and regulator Kit Two-way switch or staircase wiring Kit Series and parallel circuits Kit Transformer Kit	Connection & Trouble shooting of Fluorescent lamp wiring & Fan with switch and regulator Connection, Working & application of Two-way switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Fluorescent Lamp wiring Panel Fan with switch and regulator Kit Two-way switch or staircase wiring Kit Series and parallel circuits Kit Transformer Kit	Connection & Trouble shooting of Fluorescent lamp wiring & Fan with switch and regulator Connection, Working & application of Two-way switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Fluorescent Lamp wiring Panel Fan with switch and regulator Kit Two-way switch or staircase wiring Kit Series and parallel circuits Kit Transformer Kit	Iamp wiring & Fan with switch and regulator Connection, Working & application of Two-way switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Fan with switch and regulator Kit Two-way switch or staircase wiring Kit Series and parallel circuits Kit Transformer Kit	connection, Working & application of Two-way switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	and regulator Kit Two-way switch or staircase wiring Kit Series and parallel circuits Kit Transformer Kit	Connection, Working & application of Two-way switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Two-way switch or staircase wiring Kit Series and parallel circuits Kit Transformer Kit	Connection, Working & application of Two-way switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Series and parallel circuits Kit Transformer Kit	application of Two-way switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Series and parallel circuits Kit Transformer Kit	switch Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Series and parallel circuits Kit Transformer Kit	Connection & 71ehavior of current & voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Transformer Kit	voltage in series , parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Transformer Kit	parallel circuit Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Transformer Kit	Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Transformer Kit	Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Transformer Kit	Polarities of single phase transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter		transformer
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter		
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	$\backslash \rangle / / \wedge$	
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter		
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	· · · · · · ·
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	of Zener Diodo kit	VI characteristics of
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	VI characteristics	VI characteristics of
8. Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	of Silicon Diode kit	Silicon Diode
	Rectifier kit	Determine the
	\rightarrow	efficiency, Voltage
		regulation, ripple factor
		of rectifiers
	Characteristics of BJT in Common	Input & Output Characteristics of BJT
	Emitter	Characteristics Of BJ1
	Configuration	
v v	Characteristics of	Input & Output
in Common Source Configuration .	JFET in Common	Characteristics of JFET
	Source	
	Configuration	
11. Realization of Universal gates using basic logic gates.	Trainer kit	Universal gates will be
		realized using basic
		gates
TEXT BOOKS		
Nagrath I.J. and D. P. Kothari, "Basic Electrical Engineering", T		
Hayt and Kimberly, "Engineering Circuit Analysis", Tata McGra		013.
3. Kulshreshtha D.C., "Basic Electrical Engineering", Tata McGrav		
 Rajendra Prasad, "Fundamentals of Electrical Engineering", Pr 	rentice Hall, India, 20	09.
ef: BOS/SME/BME-2020-21-20.06.20/2021-22-05.06.21/2022-23-25.06.22/20		
200, 3111, 21111 2020-21-20.00.20, 2021-22-03.00.21, 2022-23-23.00.22, 20	023-24-10 NE 22	

- 5. Hughes, E., "Electrical Technology", Pearson, 2005.
- 6. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
- 7. D.P. Kothari, I. J. Nagrath, "Basic Electronics", McGraw Hill Education (India) Private Limited, 2014.

REFERENCE BOOKS

- 1. Theodore Wildi, "Electrical Machines, Drives and Power", Pearson Prentice Hall, 5th Edition, 2007.
- 2. Hughes, "Electrical Technology", Addison Wesley Longman Limited, 9th Edition, 2005.

JOURNALS/MAGAZINES

- International Journal of Electrical Power and Energy Systems
 (https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems)
- 2. Journal of Electrical Engineering (https://link.springer.com/journal/202)

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/108/108108076/

Course Title	Elements of	Mechanic	al Engineer	Cour	se Type	Hard	d Core	
Course Code	B20ER0201	Credits	4	\	С	lass	II Semester	
	TLP	Credits	Contact	Work	Total Number of Assessme		٨٠٠٥٠	mont in
	ILF	Credits	Hours	Load				
Course	Theory	3	3	3	Per Se	Per Semester Weightage		giitage
Structure	Practice	/1	2	2 _	Theory Practical		IA	SEE
	Tutorial	0 /	0/	Ø	THEORY	Fractical	IA	JEE
	Total	4	/ 5	5	39	26	50 %	50 %

COURSE OVERVIEW

Elements of Mechanical Engineering is a basic course of Mechanical Engineering discipline. It focuses on overall view of mechanical engineering area's like thermal, design and manufacturing streams. The course is designed to understand basic concept like formation of steam and compute the steam properties like specific volume, enthalpy, and internal energy using steam tables. The students are introduced to internal combustion engines, turbines (water, steam and gas) and refrigeration-air conditioning system. The students will be imparted to calculate BP, IP, mechanical efficiency of IC engines. The students are exposed to the machine elements like springs, belt drives and gear drives. Acquainted with different machine tools like lathe, drilling machines and CNC machines. The students will be exposed to joining processes like Soldering, Brazing and Welding and various power transmission systems. Students are introduced to the engineering materials and modern manufacturing Technology like 3D printing technology.

COURSE OBJECTIVES

- 1. To develop the basic knowledge on heat & work, steam formation, working principle of boilers, turbines, IC engines and refrigeration air conditioning systems
- 2. To incorporate the concept of different types of machine elements like springs, belt drives & chain drives
- 3. To give exposure in the field of engineering materials and manufacturing processes
- 4. To incorporate the concepts of modern manufacturing processes like CNC, 3D printing technology and its applications

COURSE OUTCOMES (Cos)

After the completion of the course, the student will be able to:

СО	Course Outcomes	Pos	PSOs
CO1	Describe the concepts of heat & work, steam formation, properties, working principle of boilers, turbines, IC engines and refrigeration – air conditioning systems	1,2,3,9,10	1,2
CO2	Explain the machine elements types and applications and Solve the numerical based on gear & belt drives.	1,2	1,2
CO3	Compare the different kinds of machine tools and select the suitable machine tool for processing the materials and different metal joining process for the different applications	1,2,3,9,10	1,2

CO4	Classify the engineering materials and discuss the concept of casting,		
CO4	CNC and 3D printing technology	1,2,3,5	1,2

			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		٧				
CO2			٧			
CO3				٧		
CO4		٧				

CO/ Pos	PO1	PO2	PO3	PO4	PO5	P06	P07	PO8	P09	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3	2	1			\wedge		/	2	1			1	2	
CO2	3	2											1	3	
CO3	3	2	1			\wedge	> /	/	2	1			3	1	
CO4	3	2	1		1/								2	1	
Average	3	2	1		1				2	1/			1.8	1.8	

BLOOM'S I	EVEL (and 31	D print	ing tech	hnolog	y S	a aiscu		conce	pt of ca		1	,2,3,5		1,2
DECON 3 E		OI 111L	COOK	31 001	COIVIL		Bl	om's	Level						
со	R	lemem (L1)	ber	Unde (L	rstand .2)		Apply (L3)		Anal	lyze 4)	Εν	aluate (L5)		Crea (L6	ite 5)
CO1				,	V										
CO2							٧								
CO3					.,				νν						
C04					V										
COURSE AR	RTICUL	ATION	MATR	RIX			^								
CO/ Pos	PO1	P02	PO3	P04	PO5	906	704	P08	604	PO10	PO11	P012	PS01	PS02	PS03
CO1	3	2	1			\triangle		/ - /	2	1			1	2	
CO2	3	2											1	3	
CO3	3	2	1			\triangle	>/		2	1			3	1	
CO4	3	2	1		1 /	\ \	/								
Δνριασρ		-											2	1	
Note: 1-Lov COURSE CO THEORY Introductio	3 N, 2-M ONTEN on to E n to b	2 nedium IT nergy S	1, 3-Hig	h ss: Cono	tept of bcock a	heat a	Unit- nd wor	ı , Stea iler.	m form	nation,	Types o	of steam	1.8 n, Stea	1 1.8	pertie
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4.	Study of Power train of Bicycle, 2-Wheeler and 4-Wheeler	Engines	Hands on Experience
5	Study of Fitting tools and preparation of fitting models(2 Models)	Fitting tools	Hands on experience
6	Study of sheet metal tools and development of pen stand and funnel	Sheet metal tools and soldering tools	Creative Thinking
7	Hands on training on basic welding joints	Welding tools	Hands on experience
8	Preparations of welding models like 3-Legged table, 4-legged table, Name boards, Window frame etc.	Welding tools	Creative Thinking & team work

TEXT BOOKS

- 1. K.R. Gopalkrishna, "Elements of Mechanical Engineering", Subhash Publishers, 12th Edition, 2012.
- 2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, 2000.

REFERENCE BOOK

1. SKH Chowdhary, AKH Chowdhary and Nirjhar Roy, "The Elements of Workshop Technology - Vol I & II", Media Promotors and publisher, 11th edition, 2001.

JOURNALS/MAGAZINES

- 1. International Journal of Machine Tools and Manufacture
- 2. International Journal of Refrigeration.

SWAYAM/NPTEL/MOOCs:

- 1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
- 2. https://www.my-mooc.com/en/categorie/mechanical-engineering
- 3. https://nptel.ac.in/cours

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COURSE OVERVIEW

Understanding biological systems, principles and concepts in order to create usable, tangible, economically viable product or process has become need of the hour. Hence irrespective of the parent engineering discipline, knowledge and expertise from pure and applied sciences is necessary to create product or process related to healthcare, agriculture, environmental issues and many more. Any engineer will have a high probability of using biology related skills and concepts to create products and processes beneficial to the mankind and as well for the sustainable environmental friendly approach. For example, the knowledge can be used to create medical devices, diagnostic equipment's, bioreactor designing, agriculture related equipment/instruments or anything related to surface science, fluid mechanism and polymer science. This course is designed to lay foundation in the field of Cell biology, Molecular biology and Genetics, so that anyone who is interested can design better product/process to enhance the overall quality of life.

COURSE OBJECTIVES

- 1. To inculcate the basic concepts of biology from engineering perspective among students
- 2. To understand the interplay between biology and engineering disciplines
- 3. To conceptualize the engineering design/process/product for life science challenges

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes	POs	PSOs
CO1	Understand the biology concepts from engineering perspective.	1	1
CO2	Develop process/product related to the field of Life Sciences.	1,3	1,2

			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	√	√				
CO2	√	√	√			

CO / POs	PO1	PO2	ьоз	PO4	PO5	9O4	PO7	PO8	60d	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					1	1								
CO2	2	2				1	1								
Average	2	2				1	1								

СО			Cour	se Outco	omes					PC	Os	PS	Os
CO1 Un	lerstand the	biology	concept	ts from e	engine	ering p	erspec	tive.		1	<u> </u>		1
CO2 Dev	elop proces	s/produc	t relate	d to the	field o	of Life S	cience	s.		1,	3	1	.,2
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со	Course Outcomes	POs	PSOs
CO1	Identify the problems that fall under the purview of human centered design process for creative problem solving.	1,2 , 9,10,12	2
CO2	Create empathy maps to visualize user attitudes and Develop innovative products or services for a customer base using ideation techniques	1,2,9,10,12	2
CO3	Build simple prototypes for problems using gathered user requirements.	1,3, 9,10,12	1,2
CO4	Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.	1,4,8,9,10,12	1,2

			Bloom's I	evel		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓			> / /		
CO2			/ / / _			
CO3			/ //			
CO4				/√		

COURSE CONTENT THEORY Unit Design Thinking Process: Types of the thinking process, Design thinking: Definithinking, Design vs Design thinking. Problem Exploration Challenge, IDEO, GE Healthcare, The Good Kitchen- Den problem selected, Survey on existing solutions for the preparation of the preparation of the preparation. Empathizing: Powerful Visualizing tool — a method to studies. Unit Defining the problems:	ition, Origin of desig ion, Case Studies fro mark Program etc., io oblem identified. connect to the user	om Embrace-Stanford Innovation dentifying the target users for the
THEORY Unit Design Thinking Process: Types of the thinking process, Design thinking: Definithinking, Design vs Design thinking. Problem Explorate Challenge, IDEO, GE Healthcare, The Good Kitchen- Den problem selected, Survey on existing solutions for the prepathizing: Powerful Visualizing tool — a method to studies. Unit	ition, Origin of desig ion, Case Studies fro mark Program etc., io oblem identified. connect to the user	om Embrace-Stanford Innovation dentifying the target users for the
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	l-Z	
POV statements from User perspective. Idea gene		o spark the innovative ideas –
Brainstorming, Mind map, Story board, Provocation etc. What is a prototype? – Prototyping as a mind-set, pro		rotatyning for products: Why wa
prototype? Fidelity for prototypes, Process of prototypin	/	•
Prototyping for digital products: What's unique for di What's unique for physical products, Preparation; Testing PRACTICE:	- / . \	
SI. No Name of the Practice Session	Tools and Techniques	Expected Skill /Ability
Identifying the problem that can be solved using Design Thinking approach	Observation and survey	Develop identifying human centered problems
Build the empathy maps for simple problems	Visualization	Develop ability to understand other's emotions
Build the detailed empathy maps for problem identified in the teams formed	Visualization	Develop ability to understand other's emotions
4 Presentation by student teams	PPT	Develop ability to express their views
Obtain the insights into user's problems and make PoV statement	Understanding	Develop making problem statements from user perception
6 Presentation by student teams	PPT	Develop ability to express their views
7 Carry out Brain storming between the groups and generate as many as ideas possible	Ideation tools	Develop innovative mind set
8 Prototype for best 3 ideas selected	Sketching, simple model making etc.	Develop prototyping techniques
9 Presentation by student teams	PPT	Develop ability to express their plan
Test the developed prototype with set of identified users	Google forms , cold calls, social media etc.	Develop understanding of various testing methods
11 Pitching final solution	PPT	Develop ability to express their views
like single user Build the detailed empathy maps for problem identified in the teams formed Presentation by student teams Obtain the insights into user's problems and make PoV statement Presentation by student teams Carry out Brain storming between the groups and generate as many as ideas possible Prototype for best 3 ideas selected Presentation by student teams Test the developed prototype with set of identified users Pitching final solution TEXT BOOKS Gavin Ambrose and Paul Harris, "Basics Design-Design Ref: BOS/SME/BME-2020-21-20.06.20/2021-22-05.06.21/2022-23-25.	ı Thinking", AVA Publi	ishers, 2010
Ref: BOS/SME/BME-2020-21-20.06.20/2021-22-05.06.21/2022-23-25.	.06.22/2023-24-10.06.23	
77	7	

- 2. Kathryn McEiroy, "Prototyping for Designers: Developing the best Digital and Physical Products", O'Relly, 2017.

 REFERENCE BOOKS

 1. Michael G. Lucha, Scott Swan, Abbie Giffin, "Design Thinking New Product Essentials from PDMA", Wiley, 7015.

 2. Vijips Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", John Wiley, 8 Sons, 2012.

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 1. Leonary, D., and Report J. F. 1997. Spark Innovation through Empathic Design, In Harvard Business Review, November-Desember 1997, 102-113.

 2. https://www.index.orm/design/thinking/page/fookint

 5. https://www.index.orm/design/thinking/page/fookint

 5. https://www.index.orm/design/thinking/page/fookint

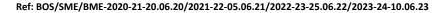
 6. https://www.index.orm/design/thinking/page/fookint

 8. https://www.index.orm/design/thinking/page/fookint

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Course Title	Laplace T	ransforms a	and Fourier S	eries	Cours	е Туре	F	С
Course Code	B20AS0304	Credits	3		Cla	ass	III sen	nester
	TLP	Credits	Contact	Work	Total Nu	ımber of	Vecoces	ment in
	ILF	Credits	Hours	Load	Cla	sses		htage
Course	Theory	3	3	3	Per Se	mester	weig	iitage
Structure	Practice	0	0	0			IA	SEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

СО	Course Outcomes	Pos	PSOs
CO1	Apply the knowledge of Laplace transformation technique to convert physical function form from the time domain to the frequency domain.	1,2,3	1
CO2	Study the periodic function, unit step function and unit impulse function by using Laplace transform.	1,2	1
CO3	Compute Inverse Laplace transform and apply them to ODEs arising in engineering	1,2	1
C04	Find the Fourier series and half range series expansion of different functions in different intervals	1,2	1
CO5	Find the Fourier & inverse Fourier transforms of different functions and apply this knowledge in solving different Mechanical engineering problems.	1,2	1
C06	Apply the numerical methods to solve various engineering problems.	1,2	1

			3 rd Sem	ester				
Course Title	Laplace	e Transforms a	and Fourier S	Series	Cours	e Type	F	:C
Course Code	B20AS030	4 Credits	3		Cla	ass	III sen	nester
	TLP	Credits	Contact	Work	Total Nu	ımber of	Assess	ment in
Course	Theory	3	Hours	Load	Clas Per Se	sses mester	Weig	htage
Structure	Practice	0	0	0	1 61 56	The Ster		T
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %
Course Title Course Code Course Structure COURSE OVERVIE In this course study and Note of the course of the cour	Il streams of /ES nowledge of nowledge of nowledge of nderstand the nderstand the nderstand the nowledge form from the periodic functions form. In Its (Cos) In Its (Cos) In Its (Cos) In Its (Cos)	Engineering processing for Laplace transfer application at the stude to the time domain applace transfer and half ransverse Fourier ving different methods to so	forms and its ce transform approach of te approach of the approach of t	the field sapplications and its and it	of Mechanicons in the fipplications of Fourier ots of Numerous functions of the Conversion of the Conv	eld of engine in the field of engine in the field of engine in the field of er series and rical method ert physical on by using arising in functions in and apply in the field of engine in the field of engin	Pos 1,2,3 1,2 1,2 1,2 1,2	PSOs 1 1 1 1 1
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СО	•		T	Level	,		1	
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CO2 1	V	√	√			√		
CO3 1	V	√	٧			٧		
CO4 1	V	٧	٧			٧		
CO5 1	V	٧	٧			٧		
CO6 \	V	٧	٧			٧		
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co/		-	~	_		.0		~	•	01	11	12	11	12	3
Pos	PO1	P02	PO3	P04	50d	90d	P07	P08	60d	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	З	3	1										2		
CO2	3	2											2		
CO3	3	2											3		
CO4	3	2											2		
CO5	3	2											2		
CO6	3	3											3		
Average	3	2.3	1										2.3		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT THEORY

Unit-1

Laplace Transforms: Definition, transforms of elementary functions, Properties-transform of $e^{at} f(t)$, $t^n f(t)$ and f(t)/t. Laplace transform of derivatives, integrals, periodic functions, unit step function and unit impulse function.

Unit-2

Inverse Laplace Transforms: Inverse Laplace Transforms, Inverse Laplace transform of standard functions, convolution theorem (without proof), Solution of linear differential equations using Laplace Transforms. Applications: Applications of Laplace transforms to Mechanical engineering problems.

Unit-3

Fourier Series: Periodic functions, Dirichlet's condition, Fourier Series of periodic functions with period 2π and with arbitrary period 2l. Fourier series of even and odd functions. Half range Fourier Series, practical harmonic analysis-Illustrative examples from engineering field.

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Applications to Mechanical engineering problems.

Unit -4

Numerical Methods: Numerical solution of algebraic and transcendental equations by Regula- Falsi Method and Newton-Raphson method.

Finite Differences: Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences- Newton's divided difference formula. Lagrange's interpolation formula and inverse interpolation formula (all formulae without proof)-Problems.

TEXT BOOKS

- 1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 48th edition.
- 2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 1st edition.

REFERENCE BOOKS

- 1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 13th edition.
- 2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition.

Course Title	Enginee	ring Thermo	dynamic	S	Cours	se Type	Hard	d Core
Course Code	B20ER0301	Credits	4	1	С	lass	III se	mester
	TLP	Credits	Contact	Work	Total N	umber of	٨٠٠٥٠	ment in
	I LF	Credits	Hours	Load	Cla	isses		ghtage
Course	Theory	3	3	3	Per Se	emester	VVEI	gniage
Structure	Practice	0	0	0	Thoony	Practical	1.0	SEE
	Tutorial	1	1	1	Theory	Practical	IA	SEE
	Total	4	4	4	52	0	50 %	50 %

CULIBSE OF	/FQ\/II	:\\/													
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fundament	als of	thermo	odynan	nics wh	nich inc	ludes t	:hermo	dynam	ic syst	ems an	nd proc	ess. T	hermo	dynam	ic laws
with applic	ation a	ınd exp	ose to	variou	s therm	nodyna	mic cy	cles. U	nderst	and the	prope	rties o	f the g	ases ar	nd pure
substances	to an	alyze 1	the pro	ocess.	Further	the c	ourse	exposé	the s	tudent	s to w	orking	of the	e devic	es like
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This course	SJECTI Onabl	VE es ara	duating	r stude	nts to 1	ındarsı	tand th	o haci	conce	ents of	thermo	dynan	nice an	d itc la	ws and
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COURSE O	JTCON	/IES (Co	os)			С СВ.		6 p. c.c.							
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СО					Cours	e Outo	omes						Pos	PS	SOs
А	pply fu	ındamı	ental co	oncept	s of the	rmody	namics	to ide	ntify sy	stem a	nd solv	е			
CO1 n	OVERVIEW Parry purpose of the course Engineering Thermodynamics is to provide the student with knowledge about entals of thermodynamics which includes thermodynamic systems and process. Thermodynamic laws dication and expose to various thermodynamic cycles. Understand the properties of the gases and pure set to analyze the process. Further the course exposé the students to working of the devices like sor and refrigeration system. OBJECTIVE rese enables graduating students to understand the basic concepts of thermodynamics and its laws and identify, analyze formulate and solve engineering problems. OUTCOMES (Cos) completion of the course, the student will be able to: Course Outcomes Apply fundamental concepts of thermodynamics to identify system and solve numerical on temperature thermodynamics to solve problems Analyze the various systems by use of first and second law of thermodynamics and solve numerical by use of first and second law of thermodynamics Solve the numerical on various thermodynamic process by applying the 1,2,6 Concept of ideal gases, real gases and pure substances Analyze basic thermodynamic scycles of various systems Solve numerical on Compressor Apply the concept of refrigeration and psychometric process to solve numerical 1,2,3 SIEVELOF THE COURSE OUTCOMES Bloom's Level Remember Understand Apply Analyze Evaluate Create (L1) Cital (L2) Cital (L3) Cital (L4) Cital (L5) Cital (L6)														
tł	nermo	dynam	ics to s	olve pr	oblems	5 <								<u> </u>	
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CO2 th	iermo	uynam dunam	ics and	ı solve	nume	rical b	y use	of firs	t and	second	ı ıaw c	of	1,2		.,∠
5,	olve th	ne nur	nerical	on va	rious ⁄f	hermo	dynam	nic pro	cess h	v annlı	ving th	e	1.2 6	1	
CO3	ncept	of ide	al gase	s, real	gases a	nd pur	e subs	tances		, «թթո	ייי סייי,	_	_,_,	1.	2,3
CO4 An	alyze k	oasic th	nermod	dynami	c cycles	of var	ious sy	stems			^		1,2	1,	2,3
CO5 So	Solve numerical on Compressor 1,2 1,2,3											2,3			
CO6 Ap	ply the concept of refrigeration and psychometric process to solve numerical 1,2,6 1,2,3														
BLOOM'S L	EVELO	F THE	COURS	SE OUT	COMES										
					$\angle \triangle$		Bl	oom's	Level	/_	<u> </u>				
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CO3				$\overline{}$			V /		V		1				
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COURSE AF	TICUL	ATION	IMATR	IX T	1	<			1				l		
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CO/ Pos	2	3	†										3	3	
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CO/ Pos CO1 CO2 CO3 CO4	3	٦	1										3	3	1
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		/ /^	Bloom	's Level	~ <i>/</i> /	>
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		٧	V			
CO2			V	V		
CO3			/ v / _	/√		
CO4			/	V V/		
CO5		٧	/ v			
CO6		٧	y			

CO/ Pos	PO1	P02	PO3	P04	PO5	P06	P07	P08	P09	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3	3											3	3	
CO2	3	3											3	3	
CO3	3	3				1							3	3	1
CO4	3	3											3	3	1
CO5	3	3											3	3	1
CO6	3	3				1							3	3	1
Average	3	3				1							3	3	1

COURSE CONTENT THEORY

Unit-1

Introduction: Thermodynamic systems and processes: Types, state, system, process and cycle. Thermal equilibrium, Zeroth law of thermodynamics and thermodynamic temperature scales. Work and heat: Thermodynamic definition, displacement work for various thermodynamic processes.

First Law of Thermodynamics: first law for a closed system undergoing cyclic and non-cyclic process, first law applied for open system- steady flow engineering devices

Unit-2

Second Law of Thermodynamics: Direct and reversed heat engine, Thermal efficiency, COP, Kelvin-Planck and Clausius statements, Equivalence of Kelvin-Planck and Clausius statements, entropy-definition and TdS relations. Ideal Gases and Pure Substances: Ideal gases: Definition, gas constant, perfect and semi perfect gases, Evaluation of heat, work, and change in internal energy, enthalpy and entropy for various quasi-static processes.

Pure substance: Properties of pure substance, phase transformation, saturated and superheated steam, dryness fraction, properties of dry, wet and superheated steam, Mollier diagram

Unit-3

Gas Power Cycles: Air-standard Otto, Diesel, dual and Brayton cycles,

Reciprocating compressor: Single stage and multi stage compression, volumetric efficiency, saving in work, optimum intermediate pressure, inter-cooling: perfect and imperfect, minimum work for compression.

√Unit-4

Vapour Power Cycle: Thermodynamic analysis of simple Rankine cycle, methods to improve cycle performance, Regeneration (open feed water) and reheating.

Refrigeration Cycle: Vapour compression refrigeration system; description, analysis, refrigerating effect. Capacity, power required, units of refrigeration, COP, Refrigerants and their desirable properties, Vapour absorption refrigeration system. Properties of moist air, psychrometric chart, basic psychrometric processes

TEXT BOOKS

- 1. P. K. Nag, "Basic and Applied Thermodynamics", Tata McGraw Hill, 2nd Edition, 2009.
- 2. R. K. Rajput, "Thermal Engineering", Lakshmi Publications, New Delhi, India, 18th Edition, 2011.

REFERENCE BOOKS

- 1. Yunus A. Cengel, "Thermodynamics: An Engineering Approach", McGraw Hill Education, 8th Edition, 2017.
- 2. S Domkundwar, C P Kothandaraman, Domkundwar, "A course in Thermal Engineering", Dhanpat Rai Publication, New Delhi India, 6th Edition, 2009,
- 3. Gordon J. Van Wylan & Richard E Sonntagg, "Fundamentals of Thermodynamics", Wiley Eastern Ltd, 7th Edition, 2009.

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/the-journal-of-chemical- thermodynamics

SWAYAM/NPTEL/MOOCs

- 1. https://nptel.ac.in/courses/112/105/112105123/
- 2. https://www.coursera.org/courses?query=thermodynamics

Course Title	[laterial Scie	nce		Cours	se Type	Hard Core			
Course Code	B20ER0302	Credits	3	3	С	lass	III se	mester		
	TLP	Credits	Contact	Work	Total N	umber of	٨٥٥٥٥٥	ment in		
	ILF	Credits	Hours	Load	Cla	isses				
Course	Theory	3	3	3	Per Se	emester	vvei	ghtage		
Structure	Practice	0	0	0	Thoony	Practical	10	SEE		
	Tutorial	0	0	0	Theory	Practical	IA	SEE		
	Total	3	3	3	39	0	50 %	50 %		

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	The subject ex	plores the stru	cture of materia	als and how the s	tructure of mat	erials can be cla	ssified	as per the	
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	science is to u	nderstand the	relationship bet	ween structure	nd properties of	of a material. Thi	s cour	se focuses	
	of fundament	als of material	, properties and	l applications. To	pics include: cr	ystal structures,	solidi	fication of	
	metals and al	lloys, defects i	n materials, ph	ase diagrams, h	eat treatment,	corrosion, types	of er	ngineering	
	materials and	characterizatio	n techniques.						
	COURSE OBJE	CTIVES	uladaa and ta a	nhanaa tha knay	dodgo of the c	trustura of mate	rials +l	hic includes	
	crystallogra	nhy microstru	cture defects a	ind diffusion	vieuge of the s	tructure or mate	וומוז נו	ilis iliciuues	
	2. To develop	the knowledg	e about the pha	ase diagrams, so	lidification, hea	t treatment pro	cess. s	tress strain	
	diagram, m	echanical prop	erties, fracture,	fatigue and cree).		, .		
	3. To enhance	the knowledge	e of iron carbon	phase diagram,	CCT, TTT diagra	ms, Hardenabilit	y, hea	t treatment	
	and corrosi	on.							
	4. To incorpor	rate the knowl	edge in various	class of enginee	ring materials,	applications and	d char	acterization	
	COURSE OUT	COMFS (Cos)							
	After the com	pletion of the o	course, the stude	ent will be able to	y: \				
	СО	•	Cours	e Outcomes		>	Pos	PSOs	
	Identify	y the structure	of materials wh	ich includes crys	allography, mic	rostructure,	1 2	122	
	defects	s, and diffusion	.\\				1,2	1,2,3	
	Identify	y various phase	es of metals and	alloys through	ppropriate pha	se diagrams			
	CO2 and wi	ill be able to	evaluate the e	ffect of alloying	elements, pro	perties and	1,2	1,2,3	
	Select	suitable heat tr	eatment proces	s hased on mate	ial properties a	nd will be to			
	CO3 provide	e suitable meth	ods to avoid cor	rosion	iai properties a	na wiji be to	1,2	1,2,3	
	Sugges	t suitable engir	neering material	s for different ap	plication and w	ill be able to			
	CO4 Correla	ite the structu	re-property rela	tionship in meta	ls/alloys in as-r	eceived and	1,2	1,2,3	
	heat tr	eated condition	ns (·			
	CO5 Describ	e the applicati	ons of super allo	oys, composites a	nd nanomateri	als	1	1,2,3	
	CO6 and to	find out the Pr	operties of meta	als and alloys	ilysis oi surrace	1	,2,5	1,2,3	
	1 1131 30								
	BLOOM'S LEV	ELOF THECOU	RSE OUTCOMES						
				Bloon	's Level				
	CO	Remember	Understand	Apply	Analyze	Evaluate		Create	
	CO1	(L1)	,/	(LO)	(L4)	(LS)	1	(LU)	
	CO2								
	CO3			†					
	CO4				√		†		
	CO5			√					
	CO6			1	√		1		
	COURSE ARTIC	CULATIONMAT	RIX						
	CO/ Pos	3 2	5.	96	90110	111	10	03	
		5 5 5	0 0	5 5		0 0	PS	PS PS	
	Ref: BOS/SME/BN	ME-2020-21-20.06	20/2021-22-05.06.2	21/2022-23-25.06.22	2023-24-10.06.23				
				83					

		Bloom's Level											
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)							
CO1		✓											
CO2			✓										
CO3				✓									
CO4				✓									
CO5			√										
CO6				✓									

CO/ Pos	0.1	0.0	03	04	05	90	07	80	60	010	011	012	501	505	503
	_	_	_	_	_	Δ.	Δ.	_	_	_	_	_	_	_	_

CO1	3	1						3	1	3
CO2	3	1						3	1	3
CO3	3	1						3	1	3
CO4	2	1						3	1	3
CO5	3	2						3	1	3
CO6	3	2		1				3	1	3
Average	2.8	1.3		1				3	1	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Structure of crystalline solids: Basic idea of lattice, crystalline and non-crystalline materials, unit cell, crystal structure of simple cubic, BCC, FCC and HCP, coordination number, packing of atoms. Simple numerical

Defects and diffusion in solids: Point, linear, planar and volume defects, edge and screw dislocations, Burger vector, grain boundaries, twin and stacking faults. Diffusion mechanism, Fick's first law and simple numericals.

Unit-2

Phase diagrams: Isomorphous and eutectic binary phase diagrams, Gibbs phase rule concept of tie line and lever rule, equilibrium and non-equilibrium cooling, microstructure development in eutectic phase diagram. Simple numerical on phase diagrams and lever rule, Solidification of metals and alloys, nucleation and growth phenomena, heterogeneous and homogeneous nucleation,

Mechanical Properties of Materials: concept of stress and strain diagram for ductile and brittle materials, Hooks law, elastic and plastic deformation, tensile properties, fatigue, fracture and creep.

Unit-3

Iron-carbon system, Fe-Fe3C diagram, invariant reactions, different phases. Effect of alloying elements. Isothermal and continuous cooling transformation (CCT) diagrams, TTT diagrams, Hardenability; Jominy-end quench test.

Fundamentals of heat treatments of Steels. Annealing, Homogenisation. Spheroidising, Normalising, Quenching media, Austempering, Martempering, Hardening and Tempering. Age hardening of Al-Cu alloy. Corrosion: introduction, Types of corrosion; dry and wet corrosion, electro chemical and oxidation (chemical) corrosion, factors influencing corrosion.

Unit-4

Engineering materials: Introduction to polymers- properties & applications of thermoplastic engineering polymers. Ceramics- classification of ceramics, applications of ceramics. Types of glasses and their chemical compositions, Physical properties of glasses.

Composite Materials: classification of composite materials based on matrix and reinforcement, matrix and fiber materials. Different types of super alloys: properties and applications of super alloys. Nanomaterials: introduction, bottom up and top down approaches.

Introduction to optical microscopic technique and working principle, Scanning and Transmission Electron **Microscopy:** Introduction to EM, construction and working principle, the necessity of characterization using SEM and TEM techniques, Diffraction: Fundamentals of Diffraction, Bragg's law, X-ray diffraction pattern of crystalline and amorphous material.

TEXT BOOKS

- 1. William D. Callister, "Materials Science and Engineering", (Adopted by R. Balasubramaniam), Wiley-Eastern. 2008.
- 2. Raghavan V, "Materials Science and Engineering A First Course", Prentice Hall, India, 2007.

REFERENCE BOOKS

1. James F. Shackelford, "Introduction to Materials Science for Engineers", Prentice Hall, India, 1996.

2. Askeland D.R.& P. P. Fullay, "The Science and Engineering of Materials", 4th Cengage Learning Publishers, 2007.

- 3. T.V. Rajan, C.P. Sharma and Ashok Sharma, "Heat Treatment Principles & Techniques", Prentice Hall of India, New Delhi.
- 4. Charles S. Barrett &T.B. Massalski, "Structure of Metals Crystallographic Methods, Principles & Data", Eurasia Publishing House (Pvt.) Ltd., New Delhi.
- 5. B.D. Cullit, "Elements of X-ray Diffraction", Addison Wesley Publishing CompanyInc., USA.
- 6. Robert E, "Physical Metallurgy Principles", Attiliated East-West Press PrivateLtd., New Delhi.

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology
- 2. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/113/102/113102080/
- 2. https://nptel.ac.in/courses/122/102/122102008/

Course Title	Manu	ıfacturing	Science		Cour	se Type	Hard Core		
Course Code	B20ER0303	Credits	4	/ ,	С	lass	III Semester		
	TLP	Credits	Contact Hours	Work Load	\	umber of asses	Assessment in Weightage		
Course	Theory	3 /	3//	3	Per Se	emester			
Structure	Practice	1	2	2	Theory	Practical	IA	SEE	
	Tutorial	0	0	0	THEOLY	Fractical	IA	JEL	
	Total	4	5	5	39	26	50 %	50 %	

COURSE OVERVIEW

Manufacturing Science is a basic course of Mechanical Engineering discipline. It focuses on overall view of mechanical engineering areas of manufacturing streams. The course is designed to understand basic concept like molding, casting, welding, metal forming, sheet metal and non-conventional machining manufacturing process. The students are exposed to the molding and joining process like Soldering, Brazing and Welding and various joining process. Students are introduced to the non-conventional machining methods working principles and applications.

COURSE OBJECTIVES

- 1. To enable the students understand the basic concepts of moulding and the sequence of processes involved in the preparation of green sand mould and sand test.
- 2. To teach students how to select the metal forming processes.
- 3. To teach students how to perform simple welding operations using Arc.
- 4. To understand the use of non-conventional machining processes.
- 5.To help students acquire knowledge about the behaviour and manufacturing properties of all engineering materials and basic concept of foundry and casting processes.
- 6. To demonstrate and give hands on training on the moulding and welding process.

COURSE OUTCOMES (Cos)

After the completion of the course, the student will be able to:

СО	Course Outcomes	Pos	PSOs
CO1	Describe the concepts of molding and working principle involved in casting process.	1, 10	1,2
CO2	Explain the metal forming process types and applications and Solve the numerical on forging and extrusion.	1, 9, 10	1,2
CO3	Compare the different metal joining process for the different applications	1,2	1,2
CO4	Discuss the working concept of Non-conventional machining and their		
C04	applications	1,5	1,2

L CO5	Demonstrate an understanding of various methods of casting process involved in manufacturing.	1,2,3,9, 10	1,2
CO6	Demonstrate to ability to solve engineering problems in welding process and manufacturing techniques for economic production.	1,2,3,9	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

			Bloom'	s Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		٧				
CO2			٧			
CO3			٧			
CO4		٧				
CO5			٧			
CO6			V			

COURSE ARTICULATION MATRIX

CO/ Pos	PO1	P02	PO3	P04	60 4	90d	PO7	804	60 d	PO10	PO11	PO12	PS01	PSO2	EOS4
CO1	3					\wedge	> /	/		3			1	2	
CO2	2								3	3			1	3	
CO3	2	1											3	1	
CO4	2		\wedge		_1								2	1	
CO5	3	1	1						3	3			1	2	
CO6	3	1	1				\rightarrow		3	> /			1	2	
Average	3	/ 1	1		1/	, \			3/	/3			1.5	1.8	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT THEORY

Unit-1

Metal Casting Processes: Casting Terminology, Pattern ,Types of Patterns, Pattern allowances, Moulds, Moulding Tools, Machines and Materials, Core, Core Making ,Sand Moulding methods , Melting furnaces fluxing, Inoculation, Die-casting processes-Cleaning, Inspection and repairing of castings.

Sand casting, Shell mould casting – Investment casting – Plaster mould casting – Ceramic mould casting – Die casting – Centrifugal casting – Melting practice and furnaces – Defects in casting – Testing and inspection of casting.

Unit-2

Metal Forming Processes: Hot working & Cold working of metals – Forging Machines – Forging operations–Rolling Types of Rolling mills – Rolling operations – Extrusion – Extrusion processes–Rod, wire and tube drawing – Bending – Principle & types- Deep drawing – Principle & Types Sheet metal forming operations such as squeezing, spinning, peen ,stretch forming and super plastic forming.

Unit-3

Fabrication Processes: Welding – Classification of welding – Electric Arc Welding- Equipment – Consumables – processes – Gas Welding – Equipment – Processes – Resistance welding – Types of Resistance welding – Soldering & Brazing – Adhesive bonding – Welding Inspection – Defects, Causes & Remedies.

Unit-4

Nonconventional Methods of Manufacturing: Introduction – Need –classification –Electro-Discharge Machining – Electro-Chemical Machining – Laser Beam Machining – Abrasive Jet Machining –Water jet Cutting Ultrasonic Machining — High Velocity Forming of Metals – Explosive Fabrication – Hydro forming – Electro-hydraulic Forming – Magnetic pulse Forming – Electron Beam Machining.

PRACTICE								
					Tools a	nd	Expect	ed Skill
SI. No	Title of the Ex	xperiment			Techniq		-	oility
1. Preparation pattern	n of Green sand	d mould ι	ising wood	en Green patter		/ooden	Hands on Ex	kperience
2. Determinat	ion of Grain Fine	ness Numb	er	Sand,	Sieving M	achine H	Hands on Ex	perience
3. Determinat	ion of Permeabil	ity Number	r	Perme	eability ma	achine H	Hands on Ex	perience
4. Determinat moulding s	cion of Compress	ive and She	ar strength	of Shear	strength r	machine H	Hands on Ex	perience
1 5 1	tion of pouring to ble Tilting Furnac		rous Metal	by Crucib	le Tilting I	Furnace (Creative Thi	nking
6 Arc welding	g – Straight line B	eads and B	utt joint	Weld	ing Tools	ŀ	Hands on ex	kperience
7 Ioint	raining on basic v			Weldi	ng tools	1	hinking Ski	III
8 Preparation Stair case	ns of welding mo	dels like 3-l	ike main ga	te, Weldi	ng tools		Creative Thi eam work	nking &
 D.K.Sngh, "Fund R.S.Parmar, "W JOURNALS/MAGA International Jo 			ixmi Publica Engineerin ology", Kha Manufactui				j, 2008 03.	
2. D.K.Sngh, "Fund 3. R.S.Parmar, "W JOURNALS/MAGA 1. International Jo 2. International Jo SWAYAM/NPTEL/ 1. https://www.co 2. https://www.m 3. https://nptel.ac							i, 2008 03.	
2. D.K.Sngh, "Fund 3. R.S.Parmar, "W JOURNALS/MAGA 1. International Jo 2. International Jo SWAYAM/NPTEL/ 1. https://www.co 2. https://www.m 3. https://nptel.ac							i, 2008 03. gineering	d Core
2. D.K.Sngh, "Fund 3. R.S.Parmar, "W JOURNALS/MAGA 1. International Jo 2. International Jo SWAYAM/NPTEL/ 1. https://www.co 2. https://www.m 3. https://nptel.ac							gineering Hard III Se	d Core mester sment in ghtage
2. D.K.Sngh, "Fund 3. R.S.Parmar, "W JOURNALS/MAGA 1. International Jo 2. International Jo SWAYAM/NPTEL/ 1. https://www.co 2. https://www.m 3. https://nptel.ac Course Title Course Code							gineering Haro III Se Assess Weig	d Core mester sment in ghtage
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2. D.K.Sngh, "Fund 3. R.S.Parmar, "W JOURNALS/MAGA 1. International Jo 2. International Jo SWAYAM/NPTEL/ 1. https://www.co 2. https://www.m 3. https://nptel.ac Course Title Course Code Course Structure							Hard III Se Assess Weig	d Core mester sment in ghtage SEE 50 %
							Hard III Se Assess Weig IA	d Core mester sment in ghtage SEE 50 %

Course Title	Mech	Mechanics of Materials Course Type					Hard Core		
Course Code	B20ER0304	Credits	4		С	lass	III Se	mester	
	TLP	Credits	Contact	Work	Total N	umber of	۸۰۰۵۰	sment in	
	ILF	Credits	Hours	Load	Cla	isses			
Course	Theory	3	3	3	Per Se	emester	Weightage		
Structure	Practice	1	2	2	Thoony	Practical	IA	SEE	
	Tutorial	0	0	0	Theory	Theory Practical		JLL	
	Total	4	5	5	39	26	50 %	50 %	

111111111111111111111111111111111111111	11111111	111111111	11111111	1111111111	1111111111	111111111	111111111	111111111	111111111	1111111111	1111111111	1111111111		11111111111	1111111
of stress (s	hear,	bendin	g, tor	sion), s	tatically	indet indet	ermina	ate sys	tems, c	lisplace	ements	and d	eformat	ions, ela	stic
stability, ar			te me	thods.	Design 6	exercis	ses are	used to	o enco	urage c	reativi	ty in st	udents.		
COURSE OF	-	_			1.00		0						1.	1	
 To devel To incor 	-			_									_		
and its a	-		-			ition o	1 30 63.	s and 5	ci aiii ai	ia to a	nucist	and the	сопсер	13 01 101.	51011
3. To incorp			_			Bendi	ing Mo	ment D	iagram	ı, Bend	ing stre	ess and	deflection	on of bea	ams
4. To under	stand	the co	ncept	s of col	umn loa	ading a	and its	effect (due to	bucklir	ng, stre	ss & st	rain in cy	linders	and
Static fa															
COURSE O		-	-					_							
After the co	omplet	tion of	the co	urse, th									D	DC C	
CO1 Exp	lain co	ncont	of stre	occ 8. ct	rain in r		itcome		ous los	ding co	anditio	nc	Pos 1,2	PSO 1,2	
		•			tresses									1,2	-
1 (02 1	npute dition		is type	L3 UI S	C33C3	anu S	ci airis,	Ciastic	CONSL	unto IC	o give	ii ioau	1,2, 9, 1	0 1,2	!
			e, Ben	ding M	oment	Diagra	ms for	vario	ıs tvne	s of be	eams u	nder			\blacksquare
				_	ary con				\wedge				1,2, 9, 1	0 1,2	<u>. </u>
	ding.	•	-		./					J	, ,				
Der	ive ge	eneral	torsio	n and	bendin	ng equ	uations	and	compu	te toro	que, b	ending			
				, bendii	ng stres	s, def	lection	of bea	ms for	differe	ent loa	ds and	1,2,9,10	1,2	
L		condit													
1 (05 1					ımns uı	nder c	differer	it load	s and	end co	onditio	ns and	1,2	1,2	
CO6 App		cripplin			dist the	failur	o of av	lindors		} /			1.2	1,2	
		/	/							/	<u>/ </u>		1,2		
DEOOIN 3 E	LVLL	OI THE	C00F	13L 00	. COIVIE.	<u>,</u>	RI	oom's	Level	_//					
со	R	emem	ber	Unde	rstand		Apply		Anal	yze	Εν	/aluate	!	Create	
		(L1)		/ (L2)		(L3)		(Le	4)		(L5)		(L6)	
CO1			*		Ŋ	>					Ţ,				
CO2							> v		\rightarrow	\rightarrow					
CO3							٧/								
CO4					-1		<u></u>		/						
CO5					V		\ <u>\</u>		-/						
COURSE AF	RTICUI	ATION	ΜΔΤΙ	RIX											
JOUNGE AI				T						0	-	7	-	2 .	,
CO/ Pos	01ء	200	203	704	305	90¢	207	30%	90¢	201	701	201	30.	SO.	ğ
CO1	3	1		 	_								3	3	-
CO2	3	2							3	3			3	3	
CO3	3	1							3	3			3	3	
CO4	3	3							3	3			3	3	
CO5	3	3							3	3			3	3	
CO6	3	3		1						_			3	3	
Average	3	2.2	<u> </u>	1					3	3			3	3	
Note: 1-Lov	w, 2-N	1edium	, 3-Hig	gh											
D. (D.)	./		20.55	0/22-		34 In									
Ref: BOS/SME	:/BME-2	2020-21-	20.06.2	0/2021-2	22-05.06.2	21/2022	2-23-25.0	6.22/20	23-24-10	0.06.23					
CO CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO/ Pos CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	:/BME-2	2020-21-	20.06.2	0/2021-2	22-05.06.2	21/2022	2- 23-25 .0	06.22/20	23-24-10).06.23					

			Bloom'	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		V				
CO2			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \			
CO3			/ v //			
CO4			\ v			
CO5		٧				
CO6			\ v	▽		

CO/ Pos	PO1	P02	PO3	P04	PO5	P06	P07	P08	P09	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3	1											3	3	
CO2	3	2							3	3			3	3	
CO3	3	1							3	3			3	3	
CO4	3	3							3	3			3	3	
CO5	3	3							3	3			3	3	
CO6	3	3											3	3	
Average	3	2.2							3	3			3	3	

	or contract		
COUR	SE CONTENT		
THEO	X T	Unit-1	
Simple	e Stress and Strain: Types of Loading	Axial Shear Concent of stress Strain	Stress-strain diagram Hooko's
law. Y	oung's modulus. Application to the /	Analysis and Design of Simple Structu	res, deformation in statically
deterr	ninate problems, Elastic Constants. co	mplementary shear stress, lateral stra	in and Poisson's ratio, Thermal
Stress	es.	, , , , , , , , , , , , , , , , , , , ,	,
		Unit-2	
Transf	ormation of Stress and Strain: Tran	sformation of plane stress, Principal	Stresses, Maximum Shearing
Stress	, Mohr's Circle for Plane Stress.		
Torsio	n: Torsion in Solid & Hollow Circular	Shafts, Torque and Power Transmitte	ed by Solid and Hollow Shafts,
Streng	tn of Shafts.	Hett 3	
Anales	cis of Roams. Chaar force and handin	Unit-3	maly supported beams under
conce	ntrated uniformly loaded varying lo	is moment ulagrams of cantilevers, sl ands and externally applied moments	with and without overbangs
Stress	es in beams: beam of uniform streng	gth, bending equation Ream Deflect	ion: slope and deflection at a
sectio	n for cantilevers under concentrated :	and uniformly distributed loads using	MaCaulay's method.
3. 3		Unit-4	,
Colum	ıns: Classification of columns, end cor	nnections, Euler's formulae and Rankir	ne Gordon equations.
Cylind	ers: Thin and thick cylinders, Lame's	Theorem, compound cylinders, Static	and Dynamic failure criteria.
PRACT	TICE		
SI. No	Title of the Experiment	Tools and	Expected Skill
J 140	The State Experiment	Techniques	/Ability
1.	Identification of Microstructure	Unit-1 Axial, Shear, Concept of stress, Strain, Analysis and Design of Simple Structumplementary shear stress, lateral strain Unit-2 Insformation of plane stress, Principal Shafts, Torque and Power Transmitted Unit-3 Ing moment diagrams of cantilevers, sinds and externally applied moments gth, bending equation, Beam Deflect and uniformly distributed loads using Unit-4 Innections, Euler's formulae and Rankin Theorem, compound cylinders, Static and Techniques Polishing Machine and Metallurgical Microscope Universal Testing Machine Universal Testing Machine Universal Testing Machine	Material Identification
2	Tensile Test	Universal Testing Machine	Hands on Experience
3.	Compression Test	Universal Testing Machine	Hands on Experience
4.	Bending Test	Universal Testing Machine	Hands on Experience
5.	Shear Test	Universal Testing Machine	Hands on Experience
6.	Torsional Test	Torsion Testing Machine	Hands on Experience
	Hardness Test	Hardness testing machine	Hands on Experience
7.	Import Tost	Pendulum type impact testing	Hands on Experience
7. 8.	impact rest	machine	I
7. 8. 9	Wear Test	machine Pin on Disc	Hands on Experience
7. 8. 9	Wear Test	Pin on Disc	Hands on Experience
7. 8. 9	Wear Test 300KS	machine Pin on Disc	Hands on Experience
7. 8. 9 TEXT I 1. F.P.	Wear Test 300KS Beer & Russell Johnstan, John T Dewo	machine Pin on Disc olf, David F Mazurek "Mechanics of Ma	Hands on Experience
7. 8. 9 TEXT I 1. F.P.	Wear Test 300KS Beer & Russell Johnstan, John T Deworaw Hill, New York, 6 th Edition, 2012.	machine Pin on Disc olf, David F Mazurek "Mechanics of Ma	Hands on Experience
7. 8. 9 TEXT 8 1. F.P. G. 2. S. H	Wear Test 300KS Beer & Russell Johnstan, John T Deworaw Hill, New York, 6 th Edition, 2012. Crandall et al., "An Introduction to N	machine Pin on Disc olf, David F Mazurek "Mechanics of Ma Mechanics of Solids (In SI Units)", McG	Hands on Experience aterials", in S.I. Units, TATA Mc raw-Hill, Third Edition, 2017.
7. 8. 9 TEXT I 1. F.P. G 2. S. H 3. Sing	Wear Test Wear Test BOOKS Beer & Russell Johnstan, John T Dewo raw Hill, New York, 6 th Edition, 2012. Crandall et al., "An Introduction to N ger, F.L. Strength of Materials, 3rd Edit	machine Pin on Disc olf, David F Mazurek "Mechanics of Ma Mechanics of Solids (In SI Units)", McG tion, Harper and Row Publishers, New	Hands on Experience aterials", in S.I. Units, TATA Mc raw-Hill, Third Edition, 2017.
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Course Title	С	ommunicati	on Skills		Cours	е Туре		FC
Course Code	B20AH0301	Credits	2		С	lass	III Se	mester
	TLP	Credits	Contact	Work	Total N	umber of		
	ILF	Credits	Hours	Load	Cla	isses	Assess	sment in
Course	Theory	2	2	2	Per Se	emester	Wei	ghtage
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	THEOLY	Fractical	IA.	JLL
	Total	2	2	2	26	0	50 %	50 %

2. International Journal of Strength of Materials SWAYAM/PTEL/MOOCS: 1. https://www.demy.com/course/basic-concepts-of-mechanics-of-materials-for-machine-design/ 2. https://jnptel.ac.in/coursey/105/106/105106172/ 3. https://www.coursera.org/learn/mechanics-1 Course Title Communication Skills Course Type FC Course Code B20AH0301 Credits 2 Class III Semester TLP Credits Hours Load Classes Weightage TLP Credits Hours Load Classes Weightage Structure Practice 0 0 0 0 Theory Practical IA SEE Tutorial 0 0 0 0 Theory Practical IA SEE Structure Practice 0 0 0 0 Theory Practical IA SEE Tutorial 0 0 0 0 Theory Practical IA SEE Structure Practice 0 0 0 0 Theory Practical IA SEE COURSE OVERVIEW This course is aimed to develop basic communication skills in English in the learners, to prioritize listening and reading skills among learners, to simplify writing skills needed for academic as well as workplace context, to examine that the learners use the electronic media such as internet and supplement the learning materials used in the classroom. COURSE OVECTIVES The objectives of this course are to: 1. Develop basic communication skills in English. 2. Emphasize on the development of speaking skills amongst learners of Engineering and Technology 3. Impart the knowledge about use of electronic media such as internet and supplement the learning materials used in the classroom. COURSE OUTCOMES (COS) The objectives of this course, the student will be able to: CO Course Outcomes (COS) Marke use of accurate writing skills using different components of academic 9, 10 communication with one or many listeners using appropriate communicative process of the strategies (Speakingskills). CO2 Bulld inferences from the text. CO3 Warke use of accurate writing skills using different components of academic 9, 10 communicate with one or many listeners using appropriate communicative process of the process of the strategies of preacting skills with clarity, confidence and comprehension and POS POS POS POS POS POS POS POS POS P		OCs:	urse/basic-cor	icepts-of-me	chanics-	of-materia	ls-for-mach	ine-desi	ign/	
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со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)							
CO1		٧											
CO2			٧										
CO3			٧										

CO4				٧
CO5		٧		
CO6		٧		

CO4														
COURSE ARTICULATION MATRIX CO/POS	CO4												ν	
COURSE ATTICULATION MATRIX 10/ POS	CO5					٧								
COURSE CONTENT THEORY: Unit - 1 Functional English: Grammar: Prepositions; Modal Auxiliaries, Reading Comprehension, Active and passive voice, Giving Instructions. Unit - 3 Multitasking Skills: Grammar: Prepositions; Modal Auxiliaries, Reading Comprehension, Active and passive voice, Giving Instructions. Unit - 3 Multitasking Skills: Grammar: Prepositions; Modal Auxiliaries, Reading Comprehension, Active and passive voice, Giving Instructions. Unit - 3 Multitasking Skills: Grammar: Tenses; Wh-questions, Compound words; Phrasal verbs, Recommendations Unit - 3 Multitasking Skills: Grammar: Direct and indirect speech, Interpreting visual materials (line graphs, pie charts etc.), Single word substitutes. TEXT BOOKS 1. Green, David, "Contemporary English Grammar Structures and Composition", New Delhi: MacMillan Publishers, 2010. 2. Thorpe, Edgar and Showick Thorpe, "Basic Vocabulary", Pearson Education India, 2012. 3. Leech, Geoffrey and Jan Svartvik, "A Communicative Grammar of English", Longman, 2003. REFERENCE BOOKS 1. Murphy, Raymond, "Murphy's English Grammar with CD", Cambridge University Press, 2004. 2. Rizvi, M. Ashraf, "Effective Technical Communication", Tata McGraw-Hill, New Delhi, 2005. 3. Riordan, Daniel, "Technical Communication", Cempage Publications, New Delhi, 2011. 4. Sen, "Communication and Language Skills", Cambridge University Press, 2015. Course Title Indian Constitution and Professional Ethics Course Type FC Course Code B20150301 Credits 2 Per Semester Weightage Tup Credits Hours Load Total Number of Classes Assessment in Weightage Structure Practice 0 O O Theory Practical IA SEE Theory 2 2 2 2 2 26 0 50 50 % 50 % COURSE OVERVIEW Theory 2 2 2 2 2 6 0 50 50 % 50 % COURSE OVERVIEW The Constitution of India lays down in defining fundamental political principles, establishes the structure,	CO6					٧								
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CO3	CO2								3					
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COG	CO4							2	3					
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Course Title	Indian Cons	titution and				se Type		FC
Course Code	B20LS0301	Credits	2		С	lass	III Se	mester
	TLP		Contact	Work	Total N	umber of		
	ILF	Credits	Hours	Load	Cla	asses	Assess	sment in
Course	Theory	2	2	2	Per Se	emester	Wei	ghtage
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	Theory	Fractical	IA	JLL
	Total	2	2	2	26	0	50 %	50 %

СО	Course Outcomes	Pos	PSOs
CO1	Analyze the Fundamental Rights, Duties and other Rights protected under Indian Constitution.	6,7,8,9, 12	
CO2	Demonstrate the practicality of Constitution perspective and make them to face the world as a bonafide citizen.	8 ,12	
CO3	Illustrate the professional ethics and human values.	6,8,12	
CO4	Summarize ethical standards followed by different companies.	7,8,12	
CO5	Demonstrate the Knowledge of Ethics to protect environment as an Engineer	6, 7, 8, 12	
C06	Apply the principles of Ethics as an employee employer in the professional life	6, 8, 9, 12	

procedu	ires, p	owers ar	nd duti	es of g	overnr	ment ir	nstitutio	ns and	sets o	ut funda	ment	al rights	s, dire	ctive pr	inciples
and dut	es of o	citizen. It	helps	to kno	w and	unders	stand th	e huma	an right	ts and h	uman	values.	It also	o helps t	o know
the mea	ning c	of ethics	and ne	ed of e	ethics i	n pers	onal and	d profe	ssional	lite.					
COURSE	OBJE	CTIVES													
1 Evola	en basi	ic knowle	course	are to	: toun	dorsta	nd Cons	titutio	n of Ind	lia					
2 Descr	ihe th	e Fundar	nental	Rights	Dutie	s and	nther Ri	citutioi øhts	i oi iiiu	ııa.					
3. Discu	ss diff	erent tyr	es of e	thics.	, Datie	.s arra	ounce in	Б. т. с.							
4. Explo	re eth	ical stan	dards f	ollowe	ed by di	ifferen	t compa	nies.							
COURSE	OUT	COMES (Cos)												
After th	e com	pletion c	f the c	ourse,	the stu	udent v	vill be a	ble to:							
СО					(Course	Outcon	nes						Pos	PSOs
CO1	Analy	/ze the F	undam	ental	Rights,	Duties	and otl	ner Rig	hts pro	tected	under	Indian	6.7	,8,9. 12	
	Const	titution.										•	-	,-,-,	
CO2	Demo	onstrate	the pra	acticali	ity of C	onstitu	ition pe	rspecti	ve and	make th	nem to	face th	ie	8 ,12	
CO2	world	as a bo	natide	citizer	nthiss	and bu	man	lucs					+ ,	0 1 2	
CO4	Sum	narizo c	hical c	londa:	etriics a	and un	man val	ent co	mpania	16			6	7 Q 12	
CO5	Dem	Onstrato	the Kn	חשופק	ge of F	thics t	o protec	t envir	onmen	nt as an	Fnging	er	6	7 R 17	
C06	Annly	v the pri	ncinles	of Fth	ics as a	n emn	lovee e	mnlove	er in the	e profes	sional	life	6,	8 9 12	
BLOOM	'S LEV	EL OF TH	IE COU	RSE O	UTCON	MES.	Aloyee el	IIIPIOYC		e profes	Sioriai		0,	0, 3, 12	
						0	E	Bloom's	s Level						
60		Remei	nber	Und	derstan	nd	Appl	y / \	Ana	alyze	E	valuate	•	Crea	ite
(0		(L1	_) /		(L2)		(L3)		· \u	(4)		(L5)		(L6	5)
CO	I					^				v					
CO	2				/v /							/			
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C06	;				V										
COURSE	ARTI	CULATIO	N MA	rix											
CO/ Pos		2	m	4	ñ	9	7	8	6	10	11	12	01	02	03
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(01	+					2		2	<u> </u>			1			
COZ	+					2		2				1			
CO4	+					+-	2	3				1			
CO5	+	_				2	2	3				1			
C06	+	+				2	+ -	3	1			1			
Average	<u>, </u>	_				2	2	3	1.5			1			
Note: 1	Low, i	2-Mediu	m, 3-Hi	gh	1	1	1	1	I	1		1	i	1	
COURSE	CON	TENT													
THEORY	':														
_							Unit	-1							
_	consti	tution: 9	Sailent	featu	res, fui	ndame	ntal rig	hts an	d dutie	es (Dire	ctive	orincipl	e and	state	policy),
Indian	uro /1 -	วka Sabh 	a & Raj	jya Sal 	oha), Ex	xecutiv	e (Pres	ident&	Gover	nor) and	d Judio	iary (Su	upren	ne court	& high
Indian (ure (LC	mposition and function of parliament, Council of ministers, prime minister, Speaker, Passing of bills.													
Indian (Legislati court), (Compo	osition ai	powers and duties of government institutions and sets out fundamental rights, directive principles of citizen. It helps to know and understand the human rights and human values. It also helps to know got ethics and need of ethics in personal and professional life. IECTIVES Wes of this course are to: assic knowledge required to understand Constitution of India. The Fundamental Rights, Duties and other Rights. Ifferent types of ethics. Tromes (Cos) Impletion of the course, the student will be able to: Course Outcomes Pos PSOs PSOs												
Indian (Legislati court), (Compo	ME 2020 3	1 20 00	20/202	1 22 05 1	06 24 /2-	122 22 25	06 22/2	0022 24 4	10.06.22					
Indian (Legislati court), (Ref: BOS/	one (LC	ME-2020-2	1-20.06.	20/202:	1-22-05.0	06.21/20	022-23-25	.06.22/2	!023-24- 1	10.06.23					

CO/ Pos	P01	P02	PO3	P04	50d) 90d	20 d	80a	60d	PO10	PO11	PO12	PS01	PSO2	PS03
CO1						2	2	/3	2			1			
CO2								3				1			
CO3						2		3				1			
CO4							2	3				1			
CO5						2	2	3				1			
C06						2		3	1			1			
Average						2	2	3	1.5			1			

Unit - 2

Human Rights: Nature and Scope of human rights, Universal protection of human rights (UDHR), Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups (children, women & old-age).

Human Values: Truth, Honesty, Loyalty, Love, Peace with examples, Difference between ethics, beliefs and morals.

Unit - 3

Ethics: Meaning, Definition, Evolution, Need of ethics, Aristotlean Ethics, Utilitarianism, Katianism, human values(Good conduct, respect for elders), ethical human conduct (Gender equality), Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

Unit -4

Engineering Ethics: Definition Scope and needs, Ethics in Consumer Protection, Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence

TEXT BOOKS

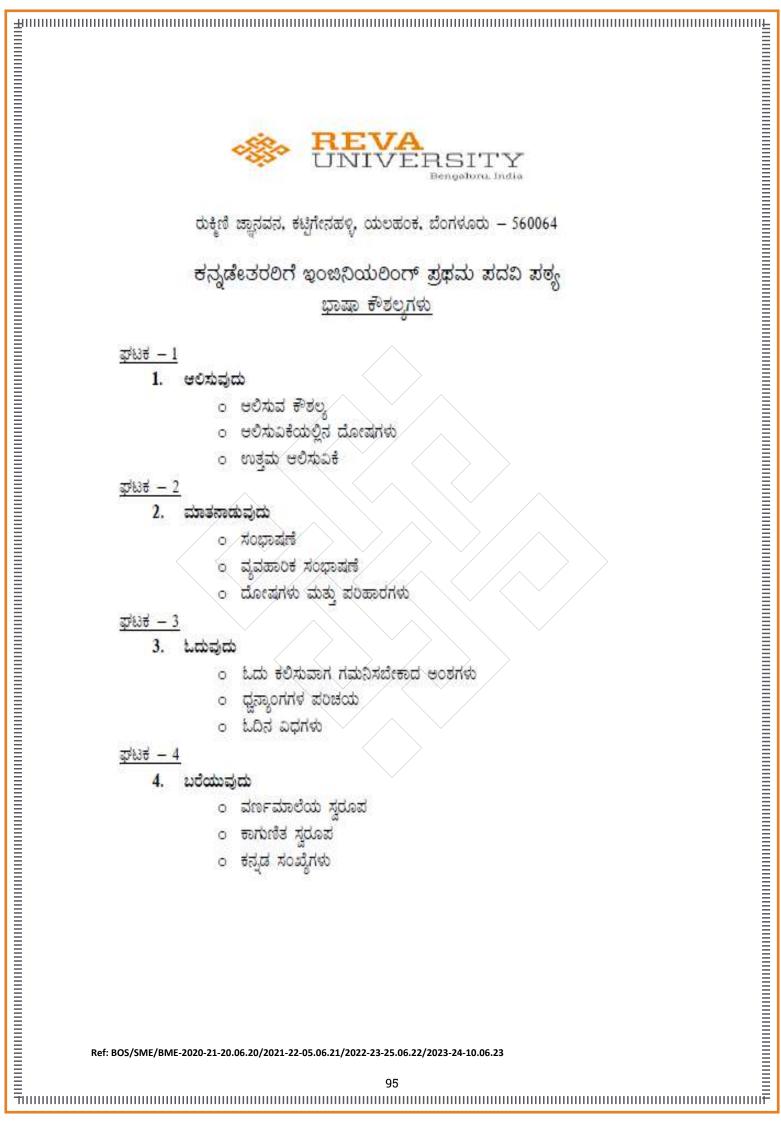
- 1. Kapoor, S.K., "Human rights under International Law and Indian Law", Prentice Hall of India, New Delhi, 2002.
- 2. Basu, D.D., "Indian Constitution", Oxford University Press, New Delhi, 2002.
- 3. Chakraborty, S.K., "Values and ethics for Organizations and Theory Practice", Oxford University Press, New Delhi, 2001.

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- 1. Meron Theodor, "Human Rights and International Law Legal Policy Issues", Vol. 1 and 2, Oxford University, Press, New Delhi, 2000.
- 2. M V Pylee, "An Introduction to Constitution of India", S Chand & Company, 5th Edition.
- 3. Durga Das Basu, "Introduction to constitution of India", LexisNexis, 23rd Edition.

Self-Learning Exercises: Abuse of Technologies: Hacking and other crimes, addiction to mobile phone usage, video games and social networking websites





ಕಾರು/swe/more-2010-1-36.53/201-12-25.50.53/2012-12-35.06.23/2012-23/2012-23-35.06.23/2012-23/20

Course Title	Probab	ility and Sa	mpling Theo	ry	Cours	е Туре	F	С
Course Code	B20AS0403	Credits	3		Cla	ass	IV sen	nester
	TLP	P Credits Contact Wor		Work	Total Nu	ımber of	٨٠٠٥٠٠	ment in
	I LF	Credits	Hours	Load	Cla	sses		htage
Course	Theory	3	3	3	Per Se	mester	vveig	iitage
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	Theory	riactical	IA	SEE
	Total	3	3	3	39	-	50 %	50 %

Course Title Pro	obability and Sai	4 TH Sem	ester rv	Cours	se Type	E	C
Course Code R20AS0A	03 Cradite	ر المسلم	- 7	Cours	lace	IV son	nester
Course code BZUASU4	us credits	Contact	Mark	Total N	umber of	iv sen	nester
TLP	Credits	Hours	Load	Cla	asses	Assessi Weig	ment in htage
Course Theory	3	3	3	Per Se	emester		
Structure Practice	e 0	0	0	Theory	Practical	IA	SEE
Total	0	3	0	20		FO 9/	FO 9/
OLIBSE OVERVIEW	3	3	3	39	-	50 %	50 %
viomatic probability theory	indonandanca	conditional	arobabili+	v Discrete	and continuo	ıc randan	a variables
Course Title Process Course Code B20AS04 TLP Course Theory Structure Practice Tutoria Total OURSE OVERVIEW xiomatic probability theory, pecial distributions of importure fitting, basic statistical correlation. Introduction to state outside the concept of curve fitting. Fundamentals of probability and regard. Concept of test of hypothe OURSE OUTCOMES (COs) fiter the completion of the course of least squares. CO2 Approximate a line of least squares. CO3 CO4 CO4 CO5 CO5 CO6 CO6 CO7 CO7 CO7 CO8 CO8 CO9 CO9 CO9 CO9 CO9 CO9	istochastic proces of and few statis ity- Random vari rding stochastic passis and able to a	tical method lables. process.	npling the	eory.	hanical engine	eering.	
fter the completion of the c	ourse, the stude	ent will be ab	le to:				
со	Cou	rse Outcome	<u>s</u>			POs	PSOs
Approximate a line	ar and non-linea	ar equation t	o the giv	en data by	the method	. 03	. 503
of least squares.		•				1,2	1
CO2 Apply the concept of problems.	of correlation and	d regression	lines for o	distinct civil	engineering	1,2	1
CO3 Define concepts of	probability spa	ice, random	variable,	discrete &	continuous	1,2,3	1
Calculate Joint prob	pabilities and der	ive the marg	inal and c	conditional	distributions	1,2	4
of bivariate random	n variables.					*	1
Define and use s	tochastic proce	esses and N	Markov c	hains in d	liscrete and	1,2	1
continuous time.		<u> </u>					
CO6 Apply sampling th	neory concepts	to solve v	arious M	1echanical	engineering	1,2	1
problems.	IDSE OLITOOMAS]
FOOIN 2 FEAST OF THE COO	INSE OUTCONES	Rin	om's Law	اد			
CO Remember(L1)	Understand(L2)	Applv(L3) An	alyze(L4)	Evaluate(L5)	Cre	ate(L6)
CO1 V	√	√ V		, - \ /	√		/
CO2 √	٧	٧			٧		
CO3 V	٧	٧			٧		
CO3	٧	٧			٧		
CO4 V		٧			٧		
CO4 √ CO5 √	V	1			٧		
CO4 V CO5 V CO6 V	√ √	٧					
CO4 V CO5 V CO6 V OURSE ARTICULATION	V V	٧			,		
CO4 V CO5 V CO6 V OURSE ARTICULATION MATRIX CO/	V V	۷ ۷		01	11 21	10	3 25

СО			Bloom'	s Level		
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1	٧	٧	٧		٧	
CO2	٧	٧	٧		٧	
CO3	٧	٧	٧		٧	
CO4	٧	٧	٧		٧	
CO5	٧	٧	٧		٧	
CO6	٧	٧	٧		٧	

CO/										0.	.1	2	1	2	3
POs	P01	P02	P03	P04	P05	90d	P07	P08	P09	P01	P01	P01	PSO	PSO	PSO

CO1	3	2						2	
CO2	3	2						2	
CO3	3	2	1					3	
CO4	3	2						2	
CO5	3	2						3	
CO6	3	2						2	
Average	3	2	1					2.3	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit -1

Curve Fitting: Curve fitting by the method of least squares and fitting of the curves of the form, y = ax + b, $y = ax^2 + bx + c$, $y = ae^{bx}$ and $y = ax^b$

Statistical Methods: Measures of central tendency and dispersion. Correlation-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression (without proof) –problems.

Unit - 2

Probability Theory: Recap of Probability theory (definition, addition theorem, multiplication theorem and conditional probability and Baye's theorem).

Probability Distributions: Random variables (discrete and continuous), probability mass/density functions, mean, variance and moments. Binomial distribution, Poisson distribution. Exponential and normal distributions, problems.

Unit - 3

Joint Probability Distribution: Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.

Stochastic Process: Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability-simple problems.

Unit - 4

Sampling Theory: Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

TEXT BOOKS

- 1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 48th edition.
- 2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 1st edition.

REFERENCE BOOKS

- 1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 13th edition.
- 2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition.

Course Title	Mechanical Me	asuremen	ts and Met	rology	Cour	se Type	Hard	d Core	
Course Code	B20ER0401	Credits	3		С	lass	IV Se	mester	
	TLP	Credits	Contact	Work	Total N	umber of			
	ILF	Credits	Hours	Hours Load		isses	Assessment in		
Course	Theory	2	2	2	Per Se	emester	Wei	ghtage	
Structure	Practice	1	2	2	The same Durantical		IA	SEE	
	Tutorial	0	0	0	Theory	Practical	IA	SEE	
	Total	3	4	4	26	26	50 %	50 %	

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COURSE	OVE	RVIE	W									_				
Metrolo	gy is	the	scien	ice of	pure	measuı	remen	t. It is	conc	erned	with t	he est	ablishr	nent, r	epro	duction,
conserva	ation	and	transf	er of u	nits of	measur	remen	ts and t	their st	andard	is. It's a	also co	ncerne	d with t	tne m	nethods,
annlicat	ions i	a est nclu	de me	on or a	ccuracy	y or me Janath	asure: diam	ments, otor ta	the m	easurin atnacc	nstni gi and sc	ument	s and t	ne insp	ecto or the	rs. Basic
intends	to in	trod	uce th	ne tech	nologi	cal and	d engi	neering	conc	epts ar	nd stuc	lv the	applica	ations o	of me	easuring
quantiti	es like	for	ce, tor	que, p	ressure	, temp	eratur	e, strai	n.			,				
COURSE	OBJE	CTI	VES													
1. Und	lersta	nd n	netrol	ogy, its	advan	cement	ts & m	easurir	ng instr	ument	s, acqu	ire kno	owledge	e on dif	feren	nt
star	ndards	s of I	length	, calibr	ation o	of End B	ars, lir	near an	d angu	ılar mea	asurem	nents.			,	
2. To i	ntrod	luce	the tu	ndame	ental co	oncepts	& de	rive the	e relat	ions to	r the d	esign o	of gaug	es, typ	es of	gauges,
3 To a	rain b	บบพา	ledge :	about	various,	anguld	s of p	essiire Essiire	speer	l and si	ırface	roughn	ness me	aguren	nent	
4. To s	explor	e th	e vario	us asn	ects re	garding	the f	orce/to	raue.	strain 8	k temn	eratur	e meas	uremer	nt.	
COURSE	OUT	CON	ΛES (C	Os)		ع، -	,	/-/-	1		.			2		
After the	e com	plet	ion of	the co	urse, th	e stude	ent wil	l be ab	e to:							
СО						Co	urse C	utcom	es /					PC	Os	PSOs
	Out	line	the o	bjectiv	es of	metrolo	ogy, m	nethods	of m	easure	ment,	standa	ards of			
CO1	mea	asur	ement	and d	escribe	slip ga	uges,	manuf	acturiń	g of sli	p gaug	es & b	uilding	1, 9,	, 10	1
	of s	lip g	auge b	locks 1	or calil	oration	/	<u>/</u>	<u> </u>	\rightarrow						
CO2	Des	cribe	e the r	need of	f limit s	ystem	and w	orking (of diffe	erent ty	pes of			1	L	1
CU3	Fnu	ıpdr	ate the	e nress	ure cr	ped an	d surf	ace rou	ghnes	s measi	Iremer	at		1		1
203	Elak	oora	te the	conce	ot of m	easurin	g forc	e, torai	ue, ten	nperati	ire and	strain		1	-	
CO4	mea	asur	ement		\//		- \				/ ,			1	L	1
CO5	Mea	asur	e the c	depth a	and thi	ckness	of the	given g	ear to	oth usir	ng gear	tooth	/	120	9 10	2
	Ver	nier	calipe	r	_/_						/		/	1,2,3	, 1U	
CO6	Den	nons	strate	the me	easurer	nent of	cuttin	g force	s, thre	ad com	ponen	ts, ang	ular	1, 2, 9	9, 10	2
BI COM	COM	ihou	ICIIES	COLUD	SE OUT	CON4E	<u>c</u>		\rightarrow							
PLOOIVI	3 LEV	LLC	2 Γ 1ΠΕ	COOK	3L 00	COIVIE	<u> </u>	BI	oom's	<u> </u>	\rightarrow					
со	,	Re	emem	ber	Unde	rstand		vlaaA		Anal	vze	Ev	valuate	.	Cre	ate
			(L1)		(1	L2)		(L3)		(L4	4)		(L5)		(L	6)
CO:	1					٧				V						
CO	2						<	٧								
CO:	3					V										
CO	1							٧								
CO	5					٧										
COC)	C: ::	ATION	D.C. A. T.	NV	٧										
COURSE	AKTI	CUL	AHUN	IVIATE	IIX 											
CO/PC	os ;	01	,02	03	90	05	90	0,	90	60	,010	011	012	SO1	302	503
CO1	+	3	- 6-			-		-		3	3	-	-	3	2	
CO2	\top	3												3	2	
1 (02	\top	3												3	2	
CO2	\neg	2												3	2	
CO2 CO3		1	1							3	3			2	3	
CO2 CO3 CO4				ı	1					3	3			2	3	
CO3 CO4 CO5		1	1													
CO2 CO3 CO4 CO5		1	1		1	•										
CO2 CO3 CO4 CO5 CO6	SME/BI	1 ME-2	020-21-	20.06.20	0/2021-2	2-05.06.	21/2022	2-23-25.0	6.22/20	23-24-10	0.06.23					
COURSE Metrolo conserva executic applicati intends quantitic COURSE 1. Und star 2. To i con 3. To g 4. To e COURSE After the CO CO1 CO2 CO3 CO4 CO5 CO6 BLOOM' CO CO1 CO2 CO3 CO4 CO5 CO6 COC CO3 CO6 COC CO6 CO7	SME/BI	1 ME-2	020-21-	20.06.20	0/2021-2	2-05.06.	21/2022	2-23-25.0	6.22/20	23-24-10	0.06.23					

			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		٧				
CO2			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \			
CO3		٧				
CO4			٧			
CO5		٧				
CO6		٧				

CO/ POs	PO1	P02	БОЗ	P04	P05	90d	PO7	80d	60d	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	3								3	3			3	2	
CO2	3												3	2	
CO3	3												3	2	
CO4	2												3	2	
C05	1	1							3	3			2	3	
C06	1	1							3	3			2	3	

Average	2.2	1				3	3		2.7	2.3	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT THEORY

Unit-1

Basic of Metrology, Linear and Angular Measurement: Objectives of metrology, role of standards, standards of length- International prototype meter, Imperial standard yard, wave length standard, subdivision of standards, line & end standard, calibration of end bars-numerical, Slip gauges, Wringing phenomenon, Numerical on building of slip gauges, Vernier bevel protractor, Angle gauges, Sine principle, Sine bar & Sine Centre.

Unit-2

Limit Gauges and Comparators: Need of limit system, Tolerance, Specification of tolerance in assembly, Accumulation tolerance & compound tolerance, principle of interchangeability & selective assembly, concept of limit of size & tolerance, Concept of fits, types of fits, shaft basis & hole basis system, geometric tolerance, tolerance grade, design of GO and NO GO gauges using Taylor's principle. Numerical on Limits, Fits and Tolerances. Comparators-types and characteristics Johanson Mikrokator, Sigma comparator, Principle of optical comparator, Zeiss ultra-optimeter, Solex pneumatic comparator, LVDT

Únit-3

Measurement of Pressure, Speed and Surface Roughness: Pressure Measurements: principle, use of elastic members in pressure measurement, Bridgeman gauge, McLeod gauge, Pirani gauge. Speed Measurement: Mechanical counters, contact and non-contact type measurement. Surface Roughness: Introduction, modes of defining surface texture, surface roughness evaluation CLA, RMS, Rmax and Rz, surface texture symbols and specifications, profilometer and Tomlinson surface meter.

Unit-4

Measurement of Force, Torque, Température and Strain Force Measurement: Analytical balance, unequal arm balance, proving ring. Torque Measurement: Prony brake and hydraulic dynamometer, Temperature Measurement: Resistance thermometer, thermocouple, law of thermocouple, materials used for construction, optical pyrometer and radiation pyrometer. Strain Measurement: Mechanical and optical strain gauge, electrical strain gauge: Bonded and unbounded resistance strain gauges, strain gauge backing and bonding materials, preparation & mounting of strain gauges.

PRACTICE

SI. No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Calibration of Micrometer using slip gauges	Micrometer, slip gauges	Hands on experience
2.	Calibration of LVDT	LVDT, Micrometer	Hands on experience
	Measurement of taper angle using Sine bar, sine	Sine bar, sine centre and	
3	centre and Roller set method.	Tapered specimen, slip	Hands on experience
	centre and Noner Set method.	gauges, rollers	
4	Measurement of effective diameter of the given	Screw thread, wire,	Hands on experience
4	screw thread by two wire / three wire method	Bench micrometer	Tranus on experience
5	Measurement of flatness by using Autocollimator	Autocollimator,	Hands on experience
3	ivieasurement of nathess by using Autocommator	Reflector, surface plate.	rialius off experience
6	Measurement of gear tooth thickness using gear	Gear tooth vernier	Hands on experience
0	tooth vernier	caliper, spur gear	rialius off experience
7	Measurement of cutting forces using lathe tool	Lathe machine with	Hands on experience
,	dynamometer	dynamometer	Hands on experience

Q	Measurement of cutting forces using drill tool	Drilling machine with	Hands on experience
0	dynamometer	dynamometer	rialius on experience

TEXT BOOKS

- 1. R.K. Jain, Engineering Metrology, Khanna Publishers, 1994.
- 2. I.C.Gupta, Engineering Metrology Dhanpath Rai Publications.

REFERENCE BOOKS

- 1. Beckwith Marangoni and Lienhard, Mechanical Measurements, Pearson Education, 6th Ed., 2006.
- 2. Anand K. Bewoor & Vinay A. Kulkarni Metrology & Measurement, Tata McGraw.
- 3. N.V Raghavendra & L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press.

JOURNALS/MAGAZINES

- 1. https://www.journals.elsevier.com/measurement
- 2. https://iopscience.iop.org/journal/0957-0233

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/112/106/112106179/
- 2. https://nptel.ac.in/courses/112/106/112106139/

Course Title	Ma	chining Pr	rocess		Cour	se Type	Har	d Core
Course Code	B20ER0402	Credits	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		c	lass	IV Se	mester
	TLP	Credits	Contact Hours	Work Load	>	umber of asses		sment in
Course	Theory	3	3	3	Per Se	emester	VVCI	giitage
Structure	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0	Theory	Fractical	IA	JLL
/	Total	4	5	5	39	26	50 %	50 %

COURSE OVERVIEW

This course would encompass a comprehensive study of metal cutting and machine tools. The students will go through the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, and drill bits, Computer Numerical Control etc. Tool geometry, chip formation, cutting force calculations and measurement, tool wear and other aspects will be given due attention.

COURSE OBJECTIVES

- 1. To familiarize the student with tool nomenclature and cutting forces
- 2. To incorporate the concepts of various machining operations to prepare a model using lathe as per dimensions
- 3. To give exposure of various machines used for manufacturing of metal components.
- 4. To incorporate the suitable super finishing process to produce the intricate components and CNC technology
- 5. To help students acquire knowledge about theory of metal cutting, mechanism of machining and analyze process parameters influence.
- 6. To explain and demonstrate the different instruments for linear and angular measurements.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes	POs	PSOs
CO1	Analyze forces acting on the cutting tool in orthogonal and oblique cutting and various process parameters to improve the cutting tool life	1,2, 9, 10	1,2
CO2	Describe various machining process used for machining of components.	1, 9, 10	1,2
CO3	Explain various machines used for manufacturing of metal components	1,2,3	1,2
CO4	Identify the cutting tools required for different machining processes.	1,2,3	1,2

	CO5	Demonstrate the cutting forces induced during the metal cutting		
	CO3	operations and understand the influence of process parameters.	1,2,3, 9, 10	1,2
Ī	CO6	Compare the working of conventional and CNC machine.	1, 2	1,2

	Bloom's Level									
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)				
CO1		٧								
CO2			٧							
CO3			٧							
CO4		٧								
CO5				٧						
CO6			٧							

Unit-4

Lapping: Principle of Lapping, Lapping methods, Advantages and limitations of lapping.

Honing: Principle of honing, Types of honing machines, Advantages, limitations and applications of honing. **Broaching**: Principle of working – Details of a commonly used broach, construction and working of a horizontal broaching machine, Advantages, limitations and applications.

CNC Machines: Overview, types, construction, tool and work holding devices, feedback devices, part programming, examples.

PRACTICE

SI. No	Title of the Experiment	Tools and	Expected Skill
31. 110	Title of the experiment	Techniques	/Ability
1	Introduction to Lathe machine and to establish the	Lathe Machine	Hands on Experience
	cutting speed, feed, depth of cut.	Lattic Widelinic	rialias on Experience
2.	Preparation of Facing and Turning model	Lathe Machine	Hands on Experience
3.	Establishing Taper turning and Step turning models	Lathe Machine	Hands on Experience
4.	Preparing Thread cutting model by defining the	Lathe Machine	Hands on Experience
	cutting speed.	Lattle Wathine	rianus on Experience
5	Producing cylindrical hole in the given model	Lathe Machine	Hands on Experience
6	Gear Cutting using milling machine	Milling Machine	Hands on Experience
7	Cutting V-Groove/Dovetail/Rectangular shapes by	Shaping machine	Hands on Experience
,	using Shaping Machine	Shaping machine	rianus on Experience
9	Demo on eccentric turning.	Lathe Machine	Knowledge

TEXT BOOKS

- 1. R.K Jain, "Production Technology", Khanna Publications, 2003.
 - 2. P N Rao, "Manufacturing Technology", McGraw-Hill Education, (Volume II), 2018
 - 3. Kalpakjian, Serope, "Manufacturing Engineering and Technology", Addison –103esley publishing co., New York

REFERENCE BOOKS

- 1. Hajra Choudhury, "Workshop Technology Vol-II", Media Promoters & Publishers Pvt. Ltd. 2004
- 2. Amitabh Ghosh and Mallik, "Manufacturing Science", affiliated East West Press, 2003
- 3. G.C Sen & Bhattacharya, "Principle of Machine Tools", Tata McGraw hill, New Delhi.

JOURNALS/MAGAZINES

- 1. International Journal of Machine Tools and Manufacture
 - 2. Journal of Manufacturing Processes

SWAYAM/NPTEL/MOOCs:

- 1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
- 2. https://onlinecourses.nptel.ac.in/noc21 me04/preview

Course Title	Kinematics a	nd Dynam	ics of Mach	ines	Cour	se Type	Hard Core		
Course Code	B20ER0403	Credits	4		Class		IV Semester		
	TLP	Credits	Contact Work		Total Number of		Accos	sment in	
	ILP	Credits	Hours	Load	Cla	Classes			
Course	Theory	3	3	3	Per Se	emester	Weightage		
Structure	Practice	1	2	2	Theory	Dractical	10	SEE	
	Tutorial	0	0	0	Theory	Practical	IA	SEE	
	Total	4	5	5	36	24	50 %	50 %	

COURSEOVERVIEW

	0111111111			1111111111	111111111111	11111111	1111111111	111111111	11111111111	11111111111		1111111111	111111111		111111111111
Kinema	tics an	ıd dynam	ics of	Machin	es is a s	ubiect	: which	deals	with th	ne basic	compo	nents	of mad	chines	and
mechan	isms .l	It also dea	als with	the stu	idy of the	e velo	city and	accele	ration	of mech	anisms	, gears	and arr	rangem	nent
of gear	trains,	types of	cam an	d follow	er. It als	o give	s an ins	ight ab	out the	balanci	ng of ro	tating	and red	ciproca	ting
parts us	ed in I	IC engine	s, CNC	Machin	eries et	. It als	so help:	s to pre	edict th	e unbal	anced a	and bal	anced	forces	and
keep th	e syste	em in dyn	amic e	quilibriu	ım betw	een th	ie movi	ng part	ts. It als	o provi	des the	gyrosco	opic pr	inciple	s on
plane di	sc, aer	roplane, s	ship, 2	and 4 w	heelers.	It also	aims a	it the s	tudy of	contro	lling for	ces on	govern	nors.	
COURSE	OBJE	CTIVES													
1. To ga	in the	knowled	ge on n	nobility	of mech	anism	s, velo	ity and	d accele	eration o	of mech	anisms	i.		
2. Comp	outatio	n of degi	ree of f	reedom	for diffe	erent i	mechan	isms a	nd mad	hines.					
3. To an	alyze v	velocity,	acceler	ation, d	ifferent	tooth	forms,	mesh a	and the	ir arran	gement	S.			
4. To int	troduc	e the cor	cept o	f gyrosc	opic effe	ct in a	ero pla	ine, shi	ip, two	wheele	r, and f	our wh	eeler v	ehicle.	
5. To ex	plain t	he worki	ng prin	cipal, m	echanis	n and	applica	ition o	f gover	nors.					
6. To de	velop	the analy	tical ap	proach	and gra	phical	metho	ds in b	alancin	g the ur	nbalanc	ed forc	es and	couple	es in
eng	ine.														
COURSE	OUTO	COMES ((cos)				/ .h- !!	<u></u>							
After th	e com	pietion o	tne co	ourse, th	ne stude	nt Will	pe abl	e to:			1			500	
CO	L.	fforest	to ±1-	√1:EE -	cours	e Out	iomes	ا، ام	oto	no	lo cita	Р0	5	PS0	5
CO1	ווטן	nerentia:	ie (Ne nand+	e airrei hair inc	tantano	ecnan	isiiis õ nter	mu a	etermi	ne, ve	iocity,	1,2, 9	, 10	1,2	
CO3	ac Ca	mputati	on of C	OF for	difforant	mech	aniemo	and c+	ructur	oc		120	10	1 2	
- 02	Co	mpare t	ho vari	ous typ	es of ge	arc ar	nd goar	train	and ov	aluatino	thair	1,2, 3	, 10	1,2	
CO3	ne	erforman	ااد vali	ous typ	es or ge	ais ai	iu geai	tiani	and Ev	aruating	\ \	1,2, 9	, 10	1,2	
CO4	. Dr	aw the v	arious (cam nro	file hase	d on t	he follo	wer m	otions	and follo	owers	123	9 10	1 2	
001	an	d their te	erminol	ogies	The Suse	0011				una ion	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	1.2,3,	J, 10	1,2	
	An	nalyze the	balan	cing/for	ces and	coupl	es polv	gon of	engine	s. and o	derive				
CO5	th	e balanci	ng con	dition fo	or rotatir	g and	recipro	câting	masse	s. / _ ^		1,2,9	, 10	1,2	
	Ev	aluate th	e perf	ormance	e of gov	ernor	and An	alvze t	he gyro	oscópic	effect				
CO6	an	ıd stabilit	v of ae	roplane	, two wh	eeler	and for	ir whe	elers.			1,2, 9	, 10	1,2	
BLOOM	'S LEV	ELOF THI	ECOUR	SE OUT	COMES								,		
							Blo	om's L	evel						
	. F	Remen	nber	Unde	rstand		Apply		Analy	ze	Evalu	ıate		reate	
СС))	(1	L2)	V	(L3)		(L4)		(L!	5)		(L6)	
СС	•	(L1			v .							•			
СО	1	(L1	,		•			1		l					
CO	1 2	(L1	,			V/	/v		/						
CO CO.	1 2 3	(L1	,		√		V		/						
CO CO.	1 2 3 4	(L1	, 		√ √		V		√ 						
CO CO CO	1 2 3 4	(L1			√ √ √		V		V V						
CO CO CO CO	1 2 3 4 5	(L1			V V V		V		V V						
CO COURSE	1 2 3 4 5 6 E ARTIO	(L1	NMATF	RIX	√ √ √ √		V		V V						
CO CO CO CO COURSE	1 2 3 4 5 6 E ARTIC	CULATIO	NMATE	RIX	V V V		V		V V	0	11	21	11	20	03
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CO COURSE CO/	1 2 3 4 5 6 E ARTIC	CULATIO	NMATE BO3	SIX	V V V V V V V V V V V V V V V V V V V	900	P07	P08	V V V 60d 3	01 01 01	P011	P012	1 1	2 2 2	PSO3
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CO C	1 2 3 4 5 6 E ARTIC	CULATIO 2 2 2 2 2 2	NMATE 03	SIX	V V V V V V V V V V V V V V V V V V V	900	VOd	804	V V V 800 3	010d 3	PO11	PO12	1 1 1 3	2 3 1	PSO3
CO C	1 2 3 4 5 6 E ARTIC	CULATIO S 2 2 2 2 2 2	NMATE BO3	8IX	V V V V	900	V V	808	V V V S S S S S S S S S S S S S S S S S	910d 3 3	PO11	P012	1 1 1 3 2	2 3 1	PSO3
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CO C	1	CULATIO 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	NMATE EOG	POP BIX	V V V V V V V V V V V V V V V V V V V	90d	V V V V V V V V V V V V V V V V V V V	808	V V V S 60d 3 3 3 3 3 3 3	910d 3 3 3 3 3	P011	P012	1 1 3 2 1	2 3 1 1 2	PSO3
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CO C	1 2 3 4 5 6 E ARTIC	CULATIO 2 2 2 2 2 2 2 2 2	NMATE EOG	GIX	V V V V V V V V V V V V V V V V V V V	900	V V V V V V V V V V V V V V V V V V V	804	V V V 3 3 3 3 3 3 3	3 3 3 3 3	PO11	P012	1 1 3 2 1 1	2 3 1 1 2 2	PSO3
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	Bloom's Level										
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)					
CO1		٧									
CO2											
CO3		٧									
CO4		٧		٧							
CO5		٧		٧							
CO6		٧		٧							

co/	P01	P02	F03	P04	50d	90 d	P07	80d	60 d	PO10	P011	PO12	PS01	PS02	PSO3
CO1	3	2							3	3			1	2	
CO2	3	2											1	3	
CO3	3	2							3	3			3	1	
CO4	3	2							3	3			2	1	
CO5	3	2							3	3			1	2	
CO6	3	2							3	3			1	2	

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е		_				J			1.5	1.0	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

THEORY

Unit-1

Introduction: Links-types, Kinematics pairs-classification, Kinematic Chain ,Constrained Motions-types, Degrees of freedom of planar mechanism, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain.

Velocity and Acceleration of Mechanism: Velocity of point in mechanism, Relative and Instantaneous Velocities in four bar and slider crank mechanism, Instantaneous center method, Types & location of instantaneous centers for different mechanisms, Kennedy's theorem. Introduction to Acceleration of a point on a link

Unit -2

Gears and Gear Trains: Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, Analysis of spur gears, Length of path of contact, contact ratio, interference & under cutting in involute gear teeth, minimum number of teeth on gear and pinion to avoid interference, Gear Trains: Simple, compound, reverted and Epicyclic gear train. (No derivation and Problems in gears and gear trains)

Cams and Followers - Classification & Terminology, Cam profile by graphical methods with knife edge and roller follower for uniform velocity, uniform acceleration and retardation, simple harmonic Simple numerical (no offset follower)

Unit 3

Balancing of Rotating Masses: Static and dynamic balancing. Balancing of several rotating masses by balancing masses in same plane and in different planes.

Balancing of Reciprocating Masses: Balancing of primary force in reciprocating engine, partial balancing of multi cylinder locomotives inline engine and V- engine. Numerical.

Unit 4

Governors: Introduction, principles, Types of governors, Terminology, force analysis of Porter, sensitivity, stability, Hunting, Isochronism, effort and power of governor, controlling force diagram. Numerical. Introduction to speed synchronizer.

Gyroscope: Principles, Gyroscopic Torque, effect of gyroscopic couple on the stability of disc, aero plane, two wheeler and four wheeler.

PRACTICE

SI. No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1 1	Analysis of 4 bar Mechanism and Slider Mechanism, 2 problems each	Adams	Hands on Experience
2.	Analysis of Cams , Gears and gear Trains	Adams	Hands on Experience
3	To determine the power, effort, controlling force, sensitiveness of the porter governor	Porter governor experimental setup	Hands on Experience
1 4	To determine the magnitude, position of unknown rotating masses using Balancing Machine.	Balancing Machine	Hands on Experience
5	Gyroscope(Demo Only)	Gyroscope	Hands on Experience
6	Analysis of gear trains and gear for a small machine component	Analyzing and suggesting	Thinking

TEXTBOOKS

1. R S Khurmi, "Theory of Machines", Schand Publishing House.

Course Title	Computer A	Aided Mac	hine Drawi	Cours	se Type	Hard Core		
Course Code	B20ER0404	Credits	3	3		lass	IV Semester	
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in
Course	Theory	1	1	/ 1	Per Se	emester	VVEI	giitage
Structure	Practice	2 /	4	4	Theory	Practical	IA	SEE
	Tutorial	0	Ø	O	Medry	Fractical	IA	SEE
	Total	3	5 _	5	12/	48	50 %	50 %

2. S S Rattan, "Theory of Machines", Tata Mc Graw Hill Education Private Limited New Delhi.

REFERENCE BOOKS:

1. Vo Singh. "Theory of Machines and Mechanisms", Oxford Higher Education International Version.

3. R K Brasal. "Theory of Machines, Lishshim Publications Ltd, New Delhi.

JOURNALS/MAGAZINES

1. Mechanism and Machine Theory | Journal | sciencedirect.com by elsevier

2. Applied Theories on Machines | Leat of High Impact Articles | Phrs | Journals | Videos (longdom.org)

3. W K Brasal. "Theory of Machines Lish of High Impact Articles | Phrs | Journals | Videos (longdom.org)

3. W WAYMM/NPEL/MOCS

1. MPEL Machinical Engineering - Theory Of Machanisms

2. http://scourseonline.lisn/res.in/course/view.php?id=522

3. dams Tutorial K for Mechanical Engineering Courses (mscoftware.com)

Course Title Computer Aided Machine Drawing Course Type Hard Core

Course Code Robert Machine | Tutorial | Section | Tutorial | Sectio

СО	Course Outcomes	POs	PSOs
CO1	Visualize and formulate detail drawing of a given object.	1,2,5,10	1,2,1

CO2 Design and sketch the orthographic view of square headed and hexagonal headed both and nut assembly as per BIS. CO3 Design and sketch single and double riveted butt joints as per stated 1,2,3,10 1,2,1 1,2,1 2,3,10 1,2,1 1,2	CO2	Desi	Design and sketch the orthographic view of square headed and hexagonal headed bolt and nut assembly as per BIS 1,2,10 1,2,1													
CO4 Design and sketch details and assembly of cotter joint and knuckle joint 1,2,3,10 1,2,1 CO5 Design and sketch details and assembly of split muff coupling, 1,2,3,10 1,2,1 CO6 Create 2-D, 3-D models and assemble the parts of mechanical systems by using standard CAD software with manufacturing considerations. BLOOM'S LEVEL OF THE COURSE OUTCOMES CO Remember Understand Apply Analyze Evaluate Create (LG) (L3) (L4) (L5) (L6) (L6) (L6) (L6) (L7) (L2) (L3) (L4) (L5) (L6) (L6) (L6) (L7) (L2) (L1) (L2) (L3) (L4) (L5) (L6) (L6) (L6) (L7) (L7) (L7) (L7) (L7) (L7) (L8) (L7) (L8) (L8) (L8) (L9) (L9) (L9) (L9) (L9) (L9) (L9) (L9	CO3	Desi	Design and sketch single and double riveted butt joints as per stated conditions. 1,2,3,10 1,2,1													
COS Design and sketch details and assembly of split muff coupling, protected type flanged coupling CO6 Create 2-D, 3-D models and assemble the parts of mechanical systems by using standard CAD software with manufacturing considerations. BLOOM'S LEVEL OF THE COURSE OUTCOMES Bloom's Level CO Remember Understand Apply (L3) (L4) (L5) (L6) (L6) CO1 V (L1) (L2) (L3) (L4) (L4) (L5) (L6) (L6) CO2 V (L7) (L6) (L6) CO3 V (L7) (L6) (L6) CO4 V (L7) (L7) (L8) (L9) (L9) (L9) (L9) (L9) (L9) (L9) (L9	CO4	Des	Design and sketch details and assembly of cotter joint and knuckle joint 1,2,1													
Cod by using standard CAD software with manufacturing considerations. 1,2,3,5,10	CO5	Desi	Design and sketch details and assembly of split muff coupling, protected type flanged coupling 1,2,3, 10 1,2,1													
Bloom's Level CO Remember Understand Apply Analyze Evaluate (L1) (L2) (L3) (L4) (L5) (L6) CO1	CO6	Crea	ate 2-D sing st	, 3-D ı andar	models d CAD s	and ass	emble with	the pa	arts of	mecha	nical sy siderati	stems	1,2	2,3,5,10	1,	2,1
CO Remember (L1) (L2) (L3) (L4) (L5) (L6) (L6) (L6) (L6) (L6) (L6) (L6) (L6	BLOOM'S L	EVEL (OF THE	COU	RSE OU	ГСОМЕ	s	DI	oom'	s Level						
CO1	со	R	emem	ber	Unde	rstand L2)		Apply (L3)		Ana (L	lyze 4)	Ev	valuate	:	Creat (L6)	е
CO2 CO3 V V CO5 CO4 V V CO5 CO6 CO6 COCCURSE ARTICULATION MATRIX CO/ POS CO CO5 CO1	CO1					٧	<									
CO4 CO5 CO6 CO6 CO6 COCOS CO6 CO7 COCOS CO7	CO2							, A								
COURSE CONTENT THEORY Unit-1 Introduction to GD&T: Limits, Fits and Tolerances, Rule of G D & T: Datum and its applications, Form Tolerance and its applications. Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine. (Bureau o Indian Standards conventions are to be followed for the drawings). Unit-2 Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag using snap head rivets). Unit-3 Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. Couplings: Split Muff coupling, protected type flanged coupling.	CO3	-				_/_		٧								
COURSE ARTICULATION MATRIX CO/ POS	CO5							\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\								
COURSE ARTICULATION MATRIX CO/ POS	CO6							/			$\overline{}$				٧	
CO/ Pos	COURSE AF	RTICUL	ATION	MAT	RIX			<u></u>								
CO1 3 2 2 2 3 1 1 1 1 CO2 3 2 2 3 1 1 1 CO3 3 2 2 2 3 1 1 1 CO4 3 1 2 2 3 1 1 1 CO4 3 1 2 2 1 1 1 CO5 3 2 2 1 1 1 CO5 3 2 2 3 3 1 1 1 CO5 3 2 2 3 3 3 1 1 1 CO5 3 2 2 3 3 3 1 1 1 CO5 3 2 2 3 3 3 1 1 1 CO5 3 2 2 3 3 3 1 1 1 CO5 3 3 2 3 3 3 1 1 1 CO5 3 3 2 3 3 3 3 1 1 1 CO5 3 3 2 3 3 3 3 1 1 1 CO5 3 3 2 3 3 3 3 1 1 1 CO5 3 3 2 3 3 3 3 1 1 1 CO5 3 3 2 3 3 3 3 1 1 1 CO5 3 3 2 3 3 3 3 1 1 1 CO5 3 3 2 3 3 3 3 1 1 1 CO5 3 3 2 3 3 3 1 1 1 CO5 3 3 2 3 3 3 1 1 1 CO5 3 3 2 3 3 3 1 1 1 CO5 3 3 2 3 3 3 1 1 1 CO5 3 3 2 3 3 3 1 1 1 CO5 3 3 2 3 3 3 1 1 1 CO5 3 3 3 1 1 1 CO5 3 3 3 1 1 1 CO5 3 3 2 3 3 3 1 1 1 CO5 3 3 3 1 1 CO5 3 3 3 1 1 CO5 3 3 3 1 CO5	CO/ POs	P01	P02	ЬОЗ	P04	POS	90d	P07	P08	P09	PO10	P011	P012	PS01	PS02	PS03
CO2 3 2 2 3 1 1 CO4 3 1 2 2 2 1 1 1 CO5 3 2 2 2 1 1 1 CO6 3 2 3 3 1 1 1 Note: 1-Low, 2-Medium, 3-High COURSE CONTENT THEORY Unit-1 Introduction to GD&T: Limits, Fits and Tolerances, Rule of G D & T: Datum and its application, Form Tolerance and its applications. Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine. (Bureau o Indian Standards conventions are to be followed for the drawings). Unit-2 Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag using snap head rivets). Unit-3 Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. Couplings: Split Muff coupling, protected type flanged coupling.	CO1	3	2	2	<u> </u>	2/			/		2		1	3	1	1
CO4 3 1 2 2 2 1 1 CO5 3 2 2 3 3 3 1 1 Note: 1-Low, 2-Medium, 3-High COURSE CONTENT THEORY Unit-1 Introduction to GD&T: Limits, Fits and Tolerances, Rule of G D & T: Datum and its application, Form Tolerance and its applications. Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine. (Bureau o Indian Standards conventions are to be followed for the drawings). Unit-2 Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag using snap head rivets). Unit-3 Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. Couplings: Split Muff coupling, protected type flanged coupling.	CO3	3	2	2						$ \leftarrow $	/ 2			3	1	1
CO5 3 2 2 3 3 3 1 1 Note: 1-Low, 2-Medium, 3-High COURSE CONTENT THEORY Unit-1 Introduction to GD&T: Limits, Fits and Tolerances, Rule of G D & T: Datum and its application, Form Tolerance and its applications. Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine. (Bureau o Indian Standards conventions are to be followed for the drawings). Unit-2 Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag using snap head rivets). Unit-3 Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. Couplings: Split Muff coupling, protected type flanged coupling.	CO4	3	1	2							2			2	1	1
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COURSE CONTENT THEORY Unit-1 Introduction to GD&T: Limits, Fits and Tolerances, Rule of G D & T: Datum and its application, Form Tolerance and its applications. Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine. (Bureau o Indian Standards conventions are to be followed for the drawings). Unit-2 Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag using snap head rivets). Unit-3 Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. Couplings: Split Muff coupling, protected type flanged coupling.	CO6	3	2	3		3/		<u></u>			3		1	3	1	1
COURSE CONTENT THEORY Unit-1 Introduction to GD&T: Limits, Fits and Tolerances, Rule of G D & T: Datum and its application, Form Tolerance and its applications. Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine. (Bureau or Indian Standards conventions are to be followed for the drawings). Unit-2 Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag using snap head rivets). Unit-3 Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. Couplings: Split Muff coupling, protected type flanged coupling.	Note: 1-Lov	w, 2-N	ledium	, 3-Hig	gh											
Introduction to GD&T: Limits, Fits and Tolerances, Rule of G D & T: Datum and its application, Form Tolerance and its applications. Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine. (Bureau or Indian Standards conventions are to be followed for the drawings). Unit-2 Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag using snap head rivets). Unit-3 Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. Couplings: Split Muff coupling, protected type flanged coupling.	COURSE CO	ONTEN	IT				•									
Introduction to GD&T: Limits, Fits and Tolerances, Rule of G D & T: Datum and its application, Form Tolerance and its applications. Orthographic Views: Conversion of pictorial views into orthographic projections of simple machine. (Bureau or Indian Standards conventions are to be followed for the drawings). Unit-2 Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag using snap head rivets). Unit-3 Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. Couplings: Split Muff coupling, protected type flanged coupling.	THEORY															
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Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly). Riveted Joints: Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag using snap head rivets). Unit-3 Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods. Couplings: Split Muff coupling, protected type flanged coupling.	_							Unit	2	_		_				
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Couplings: Split Muff coupling, protected type flanged coupling.	ialai o				·			Unit	3	£- ·						
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	Bloom's Level													
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)								
CO1		٧												
CO2		/	\ \ V \	\wedge										
CO3			V											
CO4		/ /	\ \\ \/	\wedge										
CO5			V /											
CO6						٧								

CO/ POs	PO1	20 4	PO3	PO4	POS	90d	40 4	80d	P09	PO10	P011	PO12	PS01	PSO2	PS03
CO1	3 /	2			2/					/ 2		1	3	1	1
CO2	3	2	2							2/	\wedge		/3	1	1
CO3	3	2	2				/ <			/2 <			3	1	1
CO4	3	1	2							2			2	1	1
CO5	3	2	2							3			3	1	1
CO6	3	2	3		3/					3		1	3	1	1

Unit- Assembly Drawings: Machine Vice, Plumber Block, Connand tolerance data sheet.) PRACTICE SI. No Title of the Experiment 1. Apply GD & T principles on simple machine parts 2. Draw orthographic projection of machine components 3. Draw orthographic projection of Bolts (Hexagona Head) 4. Orthographic projection of Bolts (Square Head) 5 Draw orthographic projection of riveted joints Draw orthographic projection of riveted joints Connecting two shafts like Cotter or Knuckle Joint couplings. Assemble the parts of Machine Vice and Draw the following orthographic views. a) Front view with full section b) Top View Assemble the parts of PLUMMER BLOCK and Draw the following orthographic views. a) Front view with full section b) Top View Assemble the parts of CONNECTING ROD and Draw the parts of CONNECTING	Tools and	aration of Bill of material
Assembly Drawings: Machine Vice, Plumber Block, Connand tolerance data sheet.) PRACTICE SI. No Title of the Experiment 1. Apply GD & T principles on simple machine parts Draw orthographic projection of machine	Tools and Techniques	aration of Bill of material
PRACTICE SI. No Title of the Experiment 1. Apply GD & T principles on simple machine parts Draw orthographic projection of machin	Tools and Techniques	
SI. No Title of the Experiment 1. Apply GD & T principles on simple machine parts Draw orthographic projection of machin	Tools and Techniques	
SI. No Title of the Experiment 1. Apply GD & T principles on simple machine parts Draw orthographic projection of machin	Tools and Techniques	
Apply GD & T principles on simple machine parts Draw orthographic projection of machin 2.		Expected Skill /Ability
2. Draw orthographic projection of machin	GD&T, Machine parts	Hands on Experience
components	Drawing tools and CAD Software	Hands on Experience
3. Draw orthographic projection of Bolts (Hexagona Head)	Drawing tools and CAD Software	Hands on Experience
4. Orthographic projection of Bolts (Square Head)	Drawing tools and CAD Software	Hands on Experience
5 Draw orthographic projection of riveted joints	Drawing tools and CAD Software	Creative Thinking
Draw orthographic projection of joints for connecting two shafts like Cotter or Knuckle Joint couplings.	Drawing tools and CAD Software	Creative Thinking
Assemble the parts of Machine Vice and Draw th following orthographic views. a) Front view with full section	Drawing tools and CAD Software	Hands on experience & Creative Thinking
Assemble the parts of PLUMMER BLOCK and Draw the following orthographic views. a) Front view with full section b) Top View	Drawing tools and CAD Software	Hands on experience & Creative Thinking
Assemble the parts of CONNECTING ROD and Draw the following orthographic views. a) Front view with full section b) Top View	Drawing tools and CAD Software	Hands on experience & Creative Thinking
Assemble the parts of TAILSTOCK and Draw th following orthographic views. a) Front view with full section b) Top View	Drawing tools and CAD Software	Hands of experience & Creative Thinking
 TEXT BOOKS K R Gopalakrishna, "Machine Drawing", Subhas Stores, N. D. Bhatt and V.M. Panchal, "Machine Drawing", Cha P S Gill, "Machine Drawing", Kataria & Sons, 2009 REFERENCE BOOKS Ajeet Singh, Machine Drawing Includes AutoCAD, Tata Sham Tickoo, "CAD for engineers and designers", Drea P I Vargheese and K C John, "Machine Drawing", VIP Pu Dr. Alex Krulikowski, "Fundamentals of Geometric Dimenting Edition, 2014. SWAYAM/NPTEL/MOOCS https://www.coursera.org/browse/physical-science-an https://www.my-mooc.com/en/categorie/mechanical- 	otar Publishing House, 2019 McGraw-hill, 2012. Mr Tech, 2005. Bolishers, 2011. Ensioning and Tolerancing", Md-engineering/mechanical-e	University of Michigan,

Course Title	MATLAB fo	r Mechan	ical Engine	ers	Cour	se Type	Hard	d Core
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Course Title	MATLAB	for Mechan	ical Engine	ers	Cours	se Type	Hard	Core						
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COURSE OUTCOM	ES (COs)													
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CO	c course	Cour	rse Outcome	25.	<u>,</u>		PΩs	PSOs						
CO1 Apply MAT	LAB to create a	nd manipula	ate different	types of	arrays.		1,5, 9	1,2						
				<u> </u>	<u> </u>	>	10							
CO2 Apply MAT	LAB to analyze.	represent a	nd plot 2D a	and 3D gr	aphs.		1,2,5,	9, 1,2						
	.=1.1.27.1						10							
CO3 Use MATLA	AB's built-in cap	abilities to so	olve engine	ering pro	plems invo	olving syster	ns of 1,2,5,	9, 1,2						
linear equa	ations and Curve	e fitting.		\			10							
CO4 Develop, to	est and debug I	ЛАTLAB pro	grams using	mòdern	, structur	ed programi	ming 1,2,3,	5, 1,2						
methods, i	ncluding graphi	cal user inte	rtaces	′			9, 10	<u> </u>						
CO5 Apply MA	TLAB to solve re	eal-time pro	blems in th	e areas o	of Engine	ering Mecha	nics, 1,2,3,	5, 1,2						
Strength o	r materials and	tnermal base	ed problems	5.			9, 10	<u>'</u>						
CO6 Apply MAT	LAB to solve rea	ıl-time probl	lems in the a	reas of s	tability an	alysis of fou	r and 1,2,3,	5, 1,2						
two wheel	ers						9, 10	<u>' </u>						
BLOOM'S LEVEL O	F THE COURSE	OUTCOMES												
			Bl	oom's Le	vel	1								
CO Re	emember U	nderstand	Apply		Analyze	Evalu	ate	Create						
	(L1)	(L2)	(L3)		(L4)	(L5)	(L6)						
CO1		٧												
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CO4			٧			

CO5		٧		
CO6		٧		

co/	P01	P02	PO3	P04	P05	90d	P07	PO8	P09	PO10	PO11	P012	PS01	PS02	PS03
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CO2	3	3			3				3	3			3	3	
CO3	3	2			3				3	3			3	3	
CO4	3	1	3		3				3	3			3	3	
CO5	3	2	3		3				3	3			3	3	
CO6	3	1	3		3				3	3			3	3	

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Course Title Course Code Course Structure COURSE OVERVI The course intenda strong foundate emphasizes on grounder the structure COURSE OBJECT 1. To help the structure 2. To provide the structure 3. To enable there 4. To help the structure COURSE OUTCOI After the complet CO CO1 CO2 CO3 CO4 CO4 CO4 CO4 CO4 CO4 CO4 CO5 CO5 CO5 CO5 CO6 CO7	udents gain und m tools and tec m to analyze an udents to develon MES (COs) tion of the cour se of Plan organi t production oper	erstanding chniques to d understand op cognizand see, the stude Course zational structurations through	of the fun be used in id the env ce of the ent will be e Outcom cture for a igh Work-st	ctions I the prironn Import e able les les letudy.	s and reperformment of rtance of the to:	esponsibili nance of t the organ of manage	ties of mar he manage ization. ment princ ganization	rial job. rial job. riples. POs	5	PSOs 2
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CO4 Summa	rize the HR fund	tion better			\ 			1-5		23
BLOOM'S LEVEL	OF THE COURS	E OUTCOME	S							2,3
				Blo	om's Le	evel	\			
CO R	Remember	Understand	Ar	ply		Analyze	Eval	uate	Cr	reate
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СО	Course Outcomes	POs	PSOs
CO1	Make use of Plan organizational structure for a given context in the organization carry out production operations through Work-study.	1-5	2
CO2	Analyze production operations through Work-study.	1-5	3
CO3	Understand the markets, customers and competition better and price the given products Appropriately.	1-5	2
CO4	Summarize the HR function better.	1-5	2,3

			Bloom	s Level		
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			/ V			
CO2			V			
CO3				٧		
CO4			V /			

CO/ POs	P01	P02	PO3	PO4	PO5	P06	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2										2	1	1	1	
CO2	2	1									2	1	1	1	
CO3	2										2	1	1	1	
CO4	2	1									2	1	1	1	
Average	2	1									2	1	1	1	

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importance and	Functions of Ma	anagement	Systems Ann	roach to l	Management – Taylo	r's Scientific	Management	
Theory- Taylor's	Principles of M	anagement.	Maslow's th	eory of H	ierarchy of Human N	eeds- Dougla	is McGregor's	
Theory X and Th	eorv – Hertzbe	rg Two Facto	or Theory of I	Motivatio	n – Leadershin Style	s Social resp	onsibilities of	
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aa 2 000 a20			Unit	-2				
Operations and	Marketing Ma	anagement:	Principles a	nd Types	of Plant Layout-Me	thods of Pro	duction(Job,	
batch and Mass	Production), W	ork Study –	Basic proced	ure invol	ved in Method Study	and Work N	Measurement	
– Business Proce	ss Reengineeri	ng(BPR) Stat	istical		•			
Quality Control:	control charts	for Variable	s and Attribu	ites (simp	ole Problems) and Ac	ceptance Sa	mpling, TQM,	
Six Sigma, Dem	ing's contribut	ion to quali	ty. Objective	es of Inv	entory control, EOQ	, ABC Analy	sis. Purchase	
Procedure, Stor	es Managemei	nt and Store	e Records –	JIT Syste	em, Supply Chain M	anagement,	Functions of	
Marketing, Mark	eting Mix. And	Marketing 9	Strategies ba	sed on Pr	oduct Life Cycle. Cha	nnels of dist	ribution.	
			Unit	-3				
Human Resourc	es Manageme	nt (HRM): C	Concepts of I	HRM. HR	D and Personnel Ma	anagement a	and Industrial	
Relations (PMIR	, HRM vs PMI	R. Basic func	tions of HR	Manager:	: Manpower planning	g, Recruitme	nt, Selection,	
Training and De	velopment. Pl	acement, W	/age and Sa	lary Adm	inistration, Promoti	on. Transfer	, Separation,	
Performance Ap	praisal, Grieva	nce Handlin	g and Welfa	re Admíi	nistration, Job Evalu	ation and M	lerit Rating –	
Capability Matur	ity Model (CM	M) Levels – I	Performance	Manage	ment System.			
			Unit	-4				
Strategic Mana	gement and (Contempora	ry strategic	Issues:	Mission, Goals, Obj	ectives, Pol	icy, Strategy.	
Programmes, Ele	ements of Corp	oorate Plann	ning Process,	Environ	mental Scanning. Va	lue Chain An	nalysis, SWOT	
Analysis. Steps in	Strategy Form	nulation and	implementa	tion, Gen	eric. Strategy alterna	itives. Bench	Marking and	
Balanced Score	and as Contemp	oorary Busin	ess Strategie	·S.				
TEXT BOOKS						/		
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2. Koontz and W	eihrich, "Essen	tials of mana	agement", M	cGraw Hi	ill, New Delhi, 11 th Ec	lition, 2012.		
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2 Samuel C Cer	Z. to "Modern M	anagement"	' Prontice Ha	all Now V	ork ^{9th} Edition 2013)		
3 Schermerhorn	Capling Pool	anagement	or "Manage	ment" M	liley New York 6 th F	dition 2012		
4 John A Parne	ll "Strategic M	anagement -	- Theory and	Practice'	" Cengage Publicatio	ons 2018		
5. Lawrence R J	auch. R. Gupta	and Williar	n F. Glucek.	"Busines	s Policy and Strateg	ic Managem	ent Science".	
McGraw Hil	, New York, 5 th	Edition, 201	12.	/			,	
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Course Title	Er	vironmenta	l Science		Course Type	F	С	
Course Code	B20AS0303	Credits	2		Class	IV Sen	nester	
		6 1	Contact	Work	Total Number of			
	TLP	Credits	Hours	Load	Classes Per	Assessr	nent in	
Course	Theory	2	2	2	Semester	Weigh	ntage	
Structure	Practice	0	0	0				
	Tutorial	0	0	0	Theory	IA	SEE	
	Total	2	2	2	26	50 %	50 %	
COURSE OVERV	EW .		_				,-	
J.IOL OVEILV								
Ref: BOS/SME/BME	-2020-21-20.06.20	/2021-22-05.06	5.21/2022-23-25	5.06.22/202	3-24-10.06.23			
				,				
Introduction to importance and Theory- Taylor's Theory X and Th Management. D and Decentraliza Operations and batch and Mass — Business Proce Quality Control: Six Sigma, Dem Procedure, Stor Marketing, Mark Training and De Performance Ap Capability Matural Strategic Mana Programmes, Ele Analysis. Steps in Balanced Score at East BOOKS 1. Kotler Philip a 2. Koontz and W REFERENCE BOOK 1. Thomas N. Du Edition, 201 2. Samuel C. Cer 3. Schermerhorr 4. John A. Parne 5. Lawrence R J McGraw Hill Course Title Course Code Course Code Course Code			11	2				

This introd types of renvironme COURSE O 1. Graduat an unde 2. Graduat learning 3. Will fin resourc 4. Acquire ecosyst: 5. Acquire waste n 6. Explore COURSE O After the CO CO1 CO2 CO3 CO4 CO5 BLOOM'S CO CO1 CO2 CO3 CO4 CO5 CO4 CO5 CO1 CO2 CO3 CO4 CO5 CO4 CO5 CO4 CO5 CO4 CO5 COCOS CO4 CO5 COCOS CO4 CO5 COCOS C	111111		111111111	111111111	1111111111	111111111	111111111	1111111111	111111111	111111111	1111111111			11111111	11111111111
This introd	ucto	rv cour	so is de	sianod	to intro	nduce	ou to t	he foun	dation	al conc	ents of	onviro	nmental	engin	eering
types of r	resou	urces, k	se is de biodive	rsity, 1	:hreats	and r	nethod	s of co	nserva	ation, s	sources	and	control	meası	ures of
environme	ental	pollutio	on and	ways t	o prote	ct the	enviror	ment.							
COURSE O	BJEC	CTIVES	•1•												
1. Graduat	es w ersta	/III be ta Inding o	amiliar of ethic	with ci al and	urrent a societa	ana em Lresno	ierging nsihilit	enviror ies	menta	ai engin	ieering	and gi	obal issu	ies, an	id nave
2. Graduat	es w	ill have	the al	oility to	obtain	the kr	nowled	ge, and	will re	cognize	e the ne	eed for	engagir	ng in li	fe-long
learning	g. 	_	_			_									
3. Will fin resourc	d th es.	e need	of va	rious t	ypes of	ener	gy (con	vention	al & i	non-cor	rventio	nal) re	sources	and	natural
4. Acquire	kno	owledge	e with	respe	ct to b	oiodive	rsity, t	hreats,	conse	ervation	n and	apprec	iate the	cond	cept of
5. Acquire	em. knov	wledge	about	source	s, effec	ts and	control	measu	res of	environ	ımenta	l pollut	ion, deg	radati	on and
waste n	nana	igemen	t.				/	\	2.5			,	,0	- 	
6. Explore	the v	ways fo	r prote	cting t	he envi	ronme	nt.								
After the c	Omn	OMES (pletion c	Cos)	OURSE	the stu	dent w	vill he a	ble to:							
CO	JP			33.30,	Coú	rse Ou	tcome	5 /					Pos	F	PSOs
	Un	derstan	ıd, ana	lyze aı	nd exec	cute fa	vorable	enviro	nmen	tal con	ditions				
CO1	and	d the r	ole of	indivi	dual, g	overni	ment a	nd (NG	O in	environ	mental	1,7,	8,10,12		3
	List	the ca	ı. uses /e	ffects	₹ reme	dial me	easures	and fin	d wav	s to ove	ercome				
CO2	the	m by su	uggesti	ng the	pollutio	on-con	trolled	produc	ts			1,7,	8,10,12		3
CO3	Cla	assify o	differei	nt was	stes, so	ources	of w	aste a	nd th	eir eff	ect on	1,7,	8,10,12		3
CO4	Get	t motiv	ation	to find	d new	renew	able e	nergŷ r	esour	ces wit	h high	1,7,	8,10,12		3
605	Cr	ritically	anal	yze t	he e	cologic	al im	balance	es ar	nd pro	ovide	12.	7 0 10 1		2
	re	comme	endatio	ns to p	rotect	the en	vironm	ent.				1,2,	7,0,10,12	2	5
BLOOM'S	LEVE	L OF TH	HE COL	JRSE Q	UTCON	IES		Noom's	Lovel	<u> </u>	>				
со		Reme	mber	Und	derstan	d	Appl	V	Ana	alyze	E	valuate	2	Crea	te
		(L1	1)		(L2)		(L3)		<u>(</u> 1	4)		(L5)		(L6))
CO1					٧		/	\	<u> </u>						
CO2	_	- 1	<u> </u>	+	٧	+									
CO4	\dashv	V		+	٧	+									
CO5	_				٧										
COURSE A	RTIC	ULATIC	ON MA	TRIX				1				1			
O/ Pos	01	05	03	04	05	90	07	80	60	010	011	012	S01	S02	SO3
CO1	1	_ق_	_ق	<u>ة</u>	_ ق	<u>م</u>	3	1	مَ	1	_ق	2	۵	ک	1
CO2	1						3	1		1		2			1
CO3	1						3	1		1		2			1
CO4	1	1					3	1		1		2			1
Average	1	1					3	1		1		2			1
Note: 1-Lo	w, 2	-Mediu	m, 3-H	igh	1	1	1	<u> </u>		1	1	1	. 1		<u> </u>
Ref: BOS/SM	E/BIV	1E-2020-2	21-20.06	.20/202	L-22-05.0	6.21/20	22-23-25	.06.22/2	023-24-	10.06.23					
							11	3							

со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		٧				
CO2		٧				
CO3	٧					
CO4		٧				
CO5		٧				

CO/ Pos	1	2	9	4	5	9	7	8	6	10	11	12	01	02	PSO3
	P01	ЬО	О	P04	Ю	P06	ОЬ	P08	60d	PO	О	ОЬ	PS(PS(PS(
CO1	1						3	1		1		2			1
CO2	1						3	1		1		2			1
CO3	1						3	1		1		2			1
CO4	1						3	1		1		2			1
CO5	1	1					3	1		1		2			1
Average	1	1					3	1		1		2			1

COURSE CONTENTS THEORY

Unit - 1

Basics of environment: Introduction & definition to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment.

Environmental protection: Role of Government - Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment, Environmental Legislations, Initiative and Role of Nongovernment organizations in India and world.

Unit-2

Environmental Pollution: Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil pollution, Automobile Pollution-Causes, Effects & control measures.

Environmental degradation: Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect.

Waste management: Municipal solid waste, biomedical waste and Electronic waste (E-Waste).

Unit-3

Energy: Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, Non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy.

Natural resources: Water resource - Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance. Mineral resources - Types of minerals, Methods of mining & impacts of mining activities. Forest wealth - Importance, Deforestation-Causes, effects and controlling measures

Unit-4

Ecology:-Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, **Ecosystem:** Characteristics of an Ecosystem - Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity. Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

Field Work: Visit to waste water treatment and biogas plant at REVA university campus, and/or Visit to a local polluted site-Urban/Rural/Industrial/Agricultural.

TEXT BOOKS

- 1. R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, Co-authored & Customised by Dr.MS Reddy & Chandrashekar, REVA University, 1st Edition, 2017.
- 2 R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, 2nd Edition, 2014.
- 3. Benny Joseph, "Environmental Studies", Tata McGraw Hill Publishing Company Limited, New Delhi, 2nd Edition, 2008.

REFERENCE BOOKS

- 1. Dr.S.M.Prakash, "Environmental Studies", Elite Publishers, Mangalore, 2nd Edition, 2009.
- 2. Rajagopalan R, "Environmental Studies from Crisis to cure", Oxford University Press, New Delhi, 3rd Edition, 2016
- 3. Anil Kumar Dey and Arnab Kumar Dey, "Environmental Studies", New age international private limited publishers, New Delhi, 2nd Edition, 2007.
- 4. Michael Allaby, "Basics of environmental Science", Routledge-Tayler & Francis e-library, New York, 2nd Edition, 2002.

5. Dr.Y.K Singh, "Environmental Science", New age international private limited publishers, New Delhi, 1st Edition, 2006

JOURNALS/MAGAZINES

- 1. International Journal of Environmental Science and Technology, https://www.springer.com/journal/13762/.
- 2. Journal of Environmental Sciences, https://www.journals.elsevier.com/journal-of-environmental-sciences.

SWAYAM/NPTEL/MOOCs

- 1. Environmental Studies: https://onlinecourses.swayam2.ac.in/cec19_bt03/preview
- 2. Environmental Studies: https://nptel.ac.in/courses/120/108/120108004/

SELF-LEARNING EXERCISES

- 1. Discussion on the need for public awareness on the environment, Gaia Hypothesis
- Case studies of London smog, Bhopal gas tragedy, marine pollutions and study of different waste water treatment processes, Disaster management, early warning systems-bio indicators for Tsunami and other natural disasters.
- 3. Hydrology & modern methods adopted for mining activities, remote sensing and its applications, Chernobyl (USSR) nuclear disaster and Fukushima (Japan) nuclear disaster.
- 4. Discussion on the need for balanced ecosystem and restoration of degraded ecosystems.

Course Title	Un	iversal Huma	an Values		Cour	se Type		FC	
Course Code	B20AHM401	Credits	0		C	lass	III Se	mester	
	TLP	Credits	Contact Hours	Work Load	/ /	umber of asses	Assessment in Weightage		
Course	Theory	0	2	2	Per Se	emester	vvei	gniage	
Structure	Practice	0	0	\ O\	Theory Practical		IA	SEE	
	Tutorial	0	0//	0	Theory	Fractical	IA IA	JEL	
	Total	0	2/	2	26	0	50 %	50 %	

COURSE OVERVIEW

Basic human values refer to those values which are at the core of being human. The values which are considered basic inherent values in humans include truth, honesty, loyalty, love, peace, etc. because they bring out the fundamental goodness of human beings and society at large. Tis subject focuses on developing holistic perspective and harmony on self-exploration among individuals, family and society.

COURSE OBJECTIVES

- 1. Development of a holistic perspective based on self- exploration about themselves (human being), society and nature/existence.
- 2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- ${\it 3. Strengthening of self-reflection.}\\$
- 4. Development of commitment and courage to act

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes		PSOs
	Understand the significance of value inputs in a classroom and start applying them in their life and profession.		
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	3,6,7,8,9,10	
CO3	Understand the role of a human being in ensuring harmony in society and nature.	3,6,7,8	
CO4	Demonstrate the role of human being in the abetment of pollution	3,6,7,9	
CO5	Describe appropriate technologies for the safety and security of the society as responsible human being.	9,10,11,12	

	06	Distinguish between ethical and unethical practices, and start working out the 9,10,11,12	
ľ	200	strategy to actualize a harmonious environment wherever they work.	

5. 5 -	Disti	nguish egy to a	betwee	n ethi	cal an	d unet	hical p	ractice It wher	s, and ever th	start v ey wor	working k.	g out 1	the 9,1	0,11,12	2
BLOOF	//S LEV	VEL OF	THE CO	JRSE C	ОТСО	MES									
C	0	Rem (ember L1)	Un	dersta (L2)	nd	App (L3	ly)	An (alyze L4)	E	valuat	е	Crea (L6	ate 5)
C)1		٧		٧ ٧		٧					٧			
C)3				٧										
CC)4						٧					٧			
C)5				٧			\						٧	
C)6									٧		٧			
COUR	E ART	ICULAT	ION MA	TRIX		\wedge			\wedge		ı		<u> </u>		
CO/ POs	P01	P02	PO3	P04	POS	P06	P07	808	60 ₉	PO10	P011	P012	PS01	PS02	PSO3
CO1			1	<		3	3	3	3	3	>				
CO2	<u> </u>		1	^		3	3	3	3	3/	^				
CO3			1			3	3	3	2						
COF			1		> /	3	3		3	20 /	2 ^	2			
CO5							\ <u>/</u> /		2	/ 3/	/2	2			
Happin require Happin variou Under instrum harmoneeds, Under and prorelation	ness and ments less and in mean standing mean standing st	nd Prospose for fund Prospose, Under fil' (I be ing of Prospose for its Under for its	betwee actualized THE COLOR INTERPORTATION MA TON MA	A location of aspectation of aspectation of the location of Respiring the Respiring the Respiring the location of Respirin	ok at piratio y, Meth man b seeker harmo etail. uman u ensure mean pect, D e harm nd co-	basic Hons of eing as 'Body' and en mutual ing of lifteren only in existen	Human every he control of the contro	Aspira uman I I I I I I I I I I I I I I I I I I I	tions. peing v piration ce of of phys tanding Sanyar Trust a erence spect a pciety I chensive	Right to vith the servical factor of the change of the cha	underst eir corr erstand ntient ' illity. Ur naracter Health; ne univ pect as een in erential n exter an Goa	anding ect priding and if and inderstations a correction; the footnotes on the sion of the	, Relationity. Id living the mind action appratus in and e other familisualizing.	tionship Unders in harr aterial the Boo ivities o isal of I comp r salien y): Res	o, basic tanding mony at 'Body'. dy as an of 'I' and Physical onships) alues of etence. t values olution, niversal
Under in rela Prospe	,,	order in	society	- Undiv	vided S	ociety,	Univer Un	sal Ord it- 3	er- froi	m famil	y to wo	orld fan	nily		
Under in rela Prospe harmo	nious (•									-			

CO/ POs	01	02	PO3	04	9	90	07	08	60	010	011	012	PS01	0.5	PSO3
POS	PC	PC	ΡC	PC	þα	þC) }	_ PC) 	PC	PC	PC	PS	PS	PS
CO1			1	<	<	3	3	3	3	3					
CO2			1			3 ,	3	3	3/	3/					
CO3			1 /			3	3	3							
CO4			1			3	3		3						
CO5				$\overline{}$	> /				3	3/	3 /	2			
CO6					/				2	/3	/3	2			

sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Unit-4

Natural acceptance of human values: Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order. A Ability to identify the exoper and characteristics of people friendly and eco-friendly production systems. Strategy for transition from the present state to Universal Human Order. A Jat Hu

Course Title	Design	of Machine	e Elements	5	Course Type	Hard Core
Course Code	B20ER0501	Credits	4		Class	V semester
Course	TLP	Credits	Contact Hours	Work Load	Total Number of Classes	Assessment in
Structure	Theory	3	3	3	Per Semester	Weightage

Practice	Practice 0		0	Theory	Tutorial	IA	CEE
Tutorial	1	2	2	Theory	TULOTIAI	IA	SEE
Total	4	5	5	39	26	50 %	50 %

СО	Course Outcomes	POs	PSOs
1 (() 1	Apply concepts of mechanics of materials to estimate the stresses in a machine element and predict failure of components based on theories of failure	1,2	1,2
+ $(.0)$	Evaluate the effect of impact and fatigue load on machine elements and factors affecting it.	1,2	1,2
CO3	Analyze the effect of stress concentration for various machine elements	1,2	1,2
CO4	Design machine elements like Shafts, Knuckle and Cotter joints	1,2,3	1,2
CO5	Compute the efficiency of temporary and permanent joints	1,2	1,2
CO6	Calculate the performance characteristics Fasteners and Power screws.	1,2	1,2

			Practice	<u>-</u>	0	0	0	Those	Tutorial	1.0		CEF
			Tutoria	I	1	2	2	Theory	Tutoriai	IA		SEE
COLIRSE OV	/FRV/IF	\ \ \	Total		4	5	5	39	26	50 %		50 %
Design of M	lachine	eleme	ents dea	als with	n the bas	ics of desig	n conce	pts of the	structural me	embers, i	failur	re theorie
stress conc	entrati	on, fat	igue fa	ilure. ⁻	This cou	rse covers	theorie	s of failur	e, shafts des	ign, rive	ted a	and bolte
joints, powe	er screv	ws and	l impact	tstren	gth							
COURSE OF	SJECTIV	'ES										
1. To under	stand t	he cor	cept of	norm	al, shear	and torsion	nal stre	ss, codes a	nd standard	s in the e	engin	neering in
Practice 0 0 0 Theory Tutorial IA SEE Total 1 2 2 Theory Tutorial IA SEE Total 4 5 5 3 39 26 50 % 50 % COURSE OVERVIEW Design of Machine elements deals with the basics of design concepts of the structural members, failure theories, tress concentration, fatigue failure. This course covers theories of failure, shafts design, riveted and bolted bints, power screws and impact strength COURSE OBJECTIVES To understand the concept of normal, shear and torsional stress, codes and standards in the engineering in relevance to mechanical engineering. To know the concept of static & impact strength in machine elements and theories of failure. To understand the fatigue failure. To explain the design procedure of design of shafts. To introduce the concept of safe design of riveted and bolted joints in industry applications. COURSE OUTCOMES (COs) Outset outcomes COO Course Outcomes POS PSOS Apply concepts of mechanics of materials to estimate the stresses in a machine element and predict failure of components based on theories of failure CO2 Person Apply concepts of mechanics of materials to estimate the stresses in a machine element and predict failure of components based on theories of failure CO3 Analyze the effect of impact and fatigue load on machine elements and factors affecting it. CO3 Analyze the effect of stress concentration for various machine elements 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,												
2. TO KNOW 3. To under	To understand the fatigue failure.											
4. To ander	n the d	esign i	orocedu	ure of a	design of	shafts.						
5. To introd	uce the	e conc	ept of s	afe de	sign of ri	veted and	bolted i	oints in in	dustry applic	ations.		
COURSE OL	JTCOM	ES (CC	os)		_		\		, , , ,			
After the co	mpleti	on of t	he cou	rse, th	e studen	t will be a	ole to:					
СО					Course	Outcome	s /			PC	Os	PSOs
CO1 Appl	y conc nent an	epts o	of mech	nanics ire of c	of mate	rials to e	stimate	the stress	es in a mad	hine 1	,2	1,2
CO2 Evalu	uate th	ne effe	ect of ir	mpact	and fat	gue load	on mac	hine elem	ents and fac	ctors 1	.,2	1,2
CO3 Anal	vza the	offec	t of stra	es con	centration	n for vari	nic mac	hine elem	ants A	1	2	1.2
CO4 Design	gn mac	hine	lement	s like S	Shafts Kr	nuckle and	Cotter i	oints	into	1.	2.3	1.2
CO5 Com	pute th	ne effic	iency o	of temp	orary ar	d perman	ent join	S.		1	.,2	1,2
CO6 Calcu	ulate∕th	ne perf	ormano	ce char	racțeristi	cs Fastene	rs and P	ower scre	ws.	1	,2	1,2
BLOOM'S L	EVEL O	F THE	COURS	E OUT	COMES							1
			~			В	loom's l	evel				
CO	Re	memk	er	Under	stand	Apply		Analyze	Evalu	ate	C	Create
		(L1)		(L	2)	(L3)		(L4)	(L5))		(L6)
604								\rightarrow				
CO1										,		
CO1 CO2									√	,		
CO1 CO2 CO3								1	√	,		
CO1 CO2 CO3 CO4									√			
CO1 CO2 CO3 CO4 CO5								<u> </u>	\frac{1}{\sqrt{1}}	,		
CO1 CO2 CO3 CO4 CO5 CO6	TICLU	ATION	MATEN					<u> </u>	\frac{1}{\sqrt{1}}			
CO1 CO2 CO3 CO4 CO5 CO6 COGRSE AR	TICULA	ATION	MATRIX	()				\frac{1}{\sqrt{1}}	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \			2
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR	TICUL/	MOITA	MATRIX	004	500	900	800	√ 000 0100	1100	\$012		2502 2503
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1	TICULA TICULA	ATION:	MATRIX	Ç 4004	POS	904 004	808	7 0100	P011	210 SP 3		2008 80 80 2
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2	3 3 3	2 3	MATRIX E O	F04	POS	900 b00	800	P09 000	P011	100 3 3 3		2 8 8 8 2 2 3 3
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3	3 3 3	2 3 3	MATRIX ©	O 400	PO5	PO7	800	P09 \(\frac{1}{2} \)	P011	710 3 3 3		2 3 2 3 2
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4	3 3 3 3	2 3 3 2	MATRIX ©	6 40d	POS	900 b00	80d	V	P011	100 Sd 3 3 3 3 3 3		80 8 9 9 9 9 9 9 9 9 9 9
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	2 3 3 2 3	MATRIX © 2	O 4004	SOO	906 PO6	80d	P010	P011	700 Sd 3 3 3 3 3 3 3		2 3 2 3 3 3 3
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO4 CO5	TICULA 3 3 3 3 3 3	2 3 3 2 3	MATRIX © 2	40d (POS	900 boo	PO8	V	P011	700		2 3 2 3 3 2 2 3 3 2 2 1 3 3 2 2 1 3 3 2 2 1 3 3 2 2 1 3 3 3 2 1 3 3 3 2 2 1 3 3 3 3
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average	3 3 3 3 3 3	2 3 3 2 2.5	MATRIX © 2	P04	SO0	909 PO6	800	PO9 009	P011	700 3 3 3 3 3 3 3	2	80 80 2 3 3 3 2 2.5 2.5
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Low	3 3 3 3 3 4 0, 2-Me	2 3 2 3 2 2.5 edium,	MATRIX © 2 3-High	40d (POS	900 B00	80d	P09 000	PO11	702 3 3 3 3 3 3 3	2	2 3 2 3 3 2 2.5 2.5
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Low	3 3 3 3 3 3 4, 2-Me	2 3 3 2 2.5 edium,	MATRIX © 2 3-High	P04	SOO	906 PO6	80d	PO9 009	P011	700 3 3 3 3 3 3 3	2	80 80 2 3 3 3 2 2.5 1 2.5 1
CO1 CO2 CO3 CO4 CO5 CO0 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Low	3 3 3 3 3 4 0, 2-Me	2 3 2 3 2 2.5 edium,	MATRIX © 2 3-High	40d	POS	900 00	BO8	√ 60d 00d	PO11	7104 3 3 3 3 3 3 3	2	2 3 2 3 3 2 2.5
CO6 CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Low	3 3 3 3 3 3 y, 2-Me	2 3 3 2 2.5 edium,	MATRIX © 2 3-High	P04	SOO	P06 P07	804	PO9 000	PO11	700	2	80 80 2 3 3 3 2 2.5 2.5

CO/ POs	PO1	P02	PO3	PO4	PO5	90d	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	
CO2	3	3											3	3	
CO3	3	3	2										3	2	
CO4	3	2											3	3	
CO5	3	3											3	3	
CO6	3	2											3	2	
Average	3	2.5											3	2.5	

COURSE CONTENT

Unit -1

Introduction: Definitions: normal, shear, biasaia and triaxaid stresses, Stress tensor, Principal stresses. Stress-strain diagrams for ductile and brittle materials, Failure of brittle materials, Failure of ductile materials, Failure of safety Design considerations: Codes and Standards.

Design for Static Stress, Stress Codes and Standards.

Design for Static Stress, Stress Concentration facts, simple numerical.

Link - 2

Impact strength: Introduction, Impact stress theory, Maximum shear stress theory, Distortion energy theory, Stress concentration, Design for Failure: Maximum normal stress concentration facts, simple numerical.

Design for Failure: Maximum normal stress seed us to axial & Dending load. Simple numerical.

Design for Straigue Strength: Introduction, Impact stresses due to axial & Dending load. Simple numerical.

Design for Straigue Strength: Introduction-S-AV Diagram, Low cycle failure, High cycle failure, Endurance limit, Endurance limit and Compact stresses and Soderberg's relationship Simple numerical.

Juli - 3

Design of Shafits: Materials for staff, Torsion of shafits, Design of solid and hollow shafts for strength and rigidity – design of Shafits. Materials for staff, Torsion of shafts, Design of solid and hollow shafts for strength and rigidity – design of Shafits for combined bending and axial loads.

Design of Temporary Joints: knockle joint and cottes joint.

Design of Temporary Joints: knockle joint and cottes joint.

Design of Temporary Joints: knockle joint and cottes joint.

Design of Shafits for combined bending and axial loads.

Design of Shafits Materials for shaft, Torsion of shafts, Design of solid and hollow shafts for strength and rigidity – design of Shafits for combined bending and axial loads.

Design of Shafits for combined bending and axial loads.

Design of Shafits for combined bending and axial loads.

Design of Shafits for combined bending and axial loads.

Welded Joints: Types, strength of butt and fillet welds, eccentric loading.

The str

- 1. Robert L. Norton, "Machine Design", Pearson Education Asia, 2001.
- 2. M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, "Design of Machine Elements", Pearson Education, 2006.

3. Hall, Holowenko, Laughlin (Schaum's Outlines series), "Machine Design", Adapted by S.K. Somani, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/topics/engineering/design of machine elements
- 2. https://link.springer.com/book/10.1007/978-3-319-06086-6

SWAYAM/NPTEL/MOOCs:

- 1. https://onlinecourses.nptel.ac.in
- 2. https://nptel.ac.in/courses

Course Title	Fluid Med	chanics an	d Machines	5	Cour	se Type	Hard Core		
Course Code	B20ER0502	Credits	/3		С	lass	V Sei	mester	
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in	
Course	Theory	2 /	2	2	Per Semester		Weightage		
Structure	Practice	Ø	0	/ O _	Theory	Tutorial	IA	SEE	
	Tutorial	1 /	2	2	Theoly	Tutoriai	iA.	JLL	
	Total	3	4	4	26	26	50 %	50 %	

COURSE OVERVIEW

Fluid Mechanics and Machines aims to deal with the behavior of fluids under rest and in motion. The course deals with types of fluids, properties of fluids, fluid statics, pressure measurement, fluid kinematics and fluid dynamics. This course also emphasizes the basic fluid mechanics principles and energy transfer in a hydraulic machines along with their performances. The course also highlights the viscous flow and forces over immersed bodies.

COURSE OBJECTIVES

- 1. To introduce fluid properties, measurement of fluid pressure and behavior of fluids at rest.
- 2. To identify the flow characteristics and dynamics of flow field for Engineering Applications.
- 3. To describe the importance of major and minor losses of fluid flows through pipes.
- 4. To discuss the main properties of viscous flow and flow over the immersed bodies.
- 5. To analyze the velocity components and energy transfer in fluid machines.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes	POs	PSOs
CO1	Apply the fluid properties and basic laws for analyzing fluid static applications.	1,2	1,2
CO2	Apply the principles of fluid kinematics, fluid dynamics and dimensional analysis for solving the fluid flow problems.	1,2,5	1,2
CO3	Evaluate the major and minor losses of fluid flow through pipes.	1,2	1,2
CO4	Apply the fundamentals of fluid flow for analyzing flow of viscous fluid through pipes and around immersed bodies.	1,2	1,2
CO5	Apply the fundamental concepts of energy conversion principles for analyzing fluid flow through generalized turbomachines.	1,2	1,2
CO6	Evaluate the performance parameters of power absorbing and power generating turbomachines.	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			✓			
CO4				✓		
CO5			✓			
CO6					✓	

COURSE ARTICULATION MATRIX

					1										
CO/ POs	P01	P02	PO3	P04	PO5	P06	P07	P08	P09	PO10	P011	P012	PS01	PS02	FOS4
CO1	3	2			,								3	2	
CO2	3	2			2/								3	2	
CO3	3	3		/	/		//						3	2	
CO4	3	3											3	2	
CO5	3	3					^						3	2	
CO6	3	3									\wedge		3	2	
Average	3	2.7			2								3	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Definition of a fluid, Properties of fluids, Newton's law of viscosity, types of fluid, Numerical on viscosity.

Fluid Statics: Pascal's law, Hydrostatic law, absolute, gauge, atmosphere and vacuum pressure, Manometers-simple and differential manometers. Discussion on Total pressure, Centre of pressure, Buoyancy, Centre of buoyancy, Metacenter and Meta centric height, Numerical.

Unit-2

Fluid kinematics: Types of fluid flow, flow lines, three dimensional continuity equation in (Cartesian co-ordinate system), velocity and acceleration, Discussion on velocity potential function and stream function.

Fluid Dynamics: Euler's equation of motion along stream line, Bernoulli's equation and its limitations, Applications of Bernoulli's theorem on flow measuring devices, Numerical.

Dimensional Analysis: Dimensional Homogeneity, Methods of dimensional analysis- Rayleigh's method, Buckingham π theorem, Numerical. Discussion on Similitude and Model studies.

Unit-3

Flow through pipes: Frictional loss in pipe flow, Darcy-Weisbach equation and Chezy's equation for loss of head due to friction in pipes, Discussion on minor loses in pipes, hydraulic gradient line and total energy line, Numerical.

Viscous flow: Reynolds Number, Laminar flow through circular pipes, Hagen – Poiseuille equation. (Noderivation), Numerical.

Flow over immersed bodies: Introduction, Lift and drag forces, Coefficient of lift and drag forces, Numerical.

Unit-4

Energy Exchange in Fluid machines: Fluid flow through a generalized turbomachine, Euler's turbine equation.

Centrifugal Pumps: Parts of centrifugal pump, different heads and efficiencies of centrifugal pump, minimum speed

for starting the pump, Work done by the Centrifugal pump, Pumps in series and parallel. Numerical.

Hydraulic Turbines: Classification, efficiencies of hydraulic turbines. Pelton turbine - velocity triangles, design parameters, Francis turbine - velocity triangles, design parameters, Kaplan- velocity triangles, design parameters. Numerical.

CASE STUDIES:

- 1. Develop a python programming for plot and visualization of stream line of fluid flow.
- 2. Conduct the experiment to determine the coefficient of friction for fluid flowing through pipes of different diameter and compute the same using MAT lab.
- 3. Prepare a report on any pumps used in Agricultural field/ Industry by mentioning following details: Make and specifications, operating conditions, construction, working principle, and applications.
- 4. Prepare a report on any Mini or Macro hydroelectric power station by mentioning the following details: Make and specifications, type and of number of turbines, capacity of power generation, working principle, operating conditions and applications.

TEXT BOOKS

- 1. Dr. Bansal, "A text book of Fluid Mechanics and Hydraulic Machines", R.K.Lakshmi Publications Pvt. Ltd, 9th Edition, 2018.
- 2. Jagadish Lal, "Fluid Mechanics and Hydraulic", Metropolitan Book Company, 4th Edition 2012.

REFERENCE BOOKS

- 1. Yunus A. Cengel and John M.Cimbala, "Fluid Mechanics (SI Units)", Tata McGraw Hill, 4th Edition 2019.
- 2. Pijush.K.Kundu, "Fluid Mechanics", Taylor & Francis, 3rd Edition, 2015.

JOURNALS/MAGAZINES

1. https://www.cambridge.org/core/journals/journal-of-fluid-mechanics

SWAYAM/NPTEL/MOOCs:

- 1. https://onlinecourses.nptel.ac.in/noc22_me31/preview
- 2. https://www.my-mooc.com/en/categorie/mechanical-engineering

Course Title	Thermal	Engineeri	ng Systems		Cour	se Type	Har	d Core	
Course Code	B20ER0503	Credits 4			C	lass	V Semester		
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in	
Course	Theory	4	4 /	4	Per Se	emester	vvei	giitage	
Structure	Practice	0	0	0	Theory	Practical	IA	SEE	
	Tutorial	0	0 /	0	THEOLY	Fractical	I A	JEE	
	Total	4	4	4	52	0	50 %	50 %	

COURSE OVERVIEW

Thermal Engineering plays an important role in design of many Mechanical, electrical and electronics system. The course deals with Internal Combustions engines, combustion thermodynamics, psychometry, air conditioning, boilers, gas turbines and jet propulsions. It also deals with evaluation of condenser performance and boiler efficiency.

COURSE OBJECTIVES

- 1. To study the classification testing and performance evaluation of IC Engines.
- 2. To understand the basic definitions, concepts of chemical reactions involved in combustion process.
- 3. To gain the knowledge about basic definitions and concepts of psychometry and air-conditioning.
- 4. To study different types and working principles of boilers, condensers, accessories and evaluation of boiler performance.
- 5. To evaluate the performance parameters of gas turbine and Jet Propulsion systems.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO Course Outcomes	POs	PSOs
--------------------	-----	------

CO1	Evaluate the performance of I.C Engines.	1,2	1,2
CO2	Analyze the combustion processes using thermodynamic principles.	1,2	1,2
CO3	Apply the concept of psychometry to evaluate the performance of airconditioning systems.	1,2	1,2
CO4	Identify and select the suitable boiler mountings and accessories to		
004	improve the performance of boiler.	1,2	1,2
CO5	Compute the thermal parameters to improve thermal efficiency of gas turbines.	1,2	1,2
CO6	Describe classification and working principles jet propulsion systems.	1	1,2

CO1	Eval	uate th	ne perf	ormano	e of I.C	Engine	2S.						1,2		1,2
CO2	Ana	lyze th	e comb	ustion	process	es usir	ng theri	modyr	amic p	rinciple	2S.		1,2		1,2
CO3	App	ly the	conce	ot of p	sychome	etry to	evalu	ate th	e perfo	rmanc	e of a	ir-	1,2		1,2
	Ider	lentify and select the suitable boiler mountings and accessories to													
CO4	imp	aluate the performance of I.C Engines. alyze the combustion processes using thermodynamic principles. 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2													
CO5	Con	ipute 1	the the	ermal p	aramete	ers to	improv	e the	rmal ef	ficienc	y of g	as	1.2		1.2
	turb	ines.													_,_
CO6	Des	cribe cl	lassific	etion ar	ITCOME	ing prii	nciples	jet pro	opulsion	n syste	ms.		1		1,2
BLOOIVI 3 L	LEVE	OF IT	ie COO	K3E UU	TCOIVIE	.5	Bl	oom's	Level						
со		Reme	mber	Und	erstand		Apply		Ana	lyze	E	valuate	e	Crea	ite
		(L1	L)		(L2)		(L3)		(L	4)		(L5)		(L6	5)
CO1							V								
CO2	\perp						√ √								
CO3	\perp			1			, v								
COF	+			1	/		V								
COS	+				<u>/</u> /				$\overline{}$						
COURSE AF	RTICL	JLATIC	N MA	RIX			/			\rightarrow					
		Τ.								/o.	H _	7	1	2	8
CO/ POs	P01	P02	PQ.	P04	PO5	PO6	P07	P08	P09	P01	P01	P01	PSO	PSO	PSO
CO1	3	2/		$\langle \rangle$						> /			1	2	
CO2	3	3											1	3	
CO3	3	3							/				1	2	
COF	3	$\frac{1}{\sqrt{2}}$		/							<u> </u>		1	2	1
CO6	3	$\frac{2}{2}$											1	2	
Average	3	2.3	3										1	2.2	1
Note: 1-Lov	w, 2-	Mediu	m, 3-H	gh								1	1		I.
I.C.Engines detonation Alternate F Combustion combustion	Classic Classi	NT ssificati formar ermod uations mbusti	ion of I nce an ynami s, Exha ion effi	C engin alysis of cs: Theo ust gas ciency.	es, Com f I.C Eng pretical analysis	bustio gines, l (Stoich , A/F r	United on of SI neat based on of SI neat based on one of the second of the second on of the	engine alance ric) air nthalp	e and CI sheet, for com y of for	engine Morse hbustio	e, Deto test, I on of fu	nation C Engii iels. Ex alpy ar	and fane fue cess and ind inte	ictors af ls, Ratir ir, balar ernal en	ffectinngs and
Psychomet Heating, Co streams. Air Condition round air co	trics: poling oning ondit	Psycholog, Dehu g, Dehu g Syste tioning	ometri umidifi e ms: Pr	c propo cation a	erties o and Hur air con	f Air, nidifica	Psycho ation, E ng: Sun Unit -	ometri ivapor nmer a	c Chart ative Co	:, Anal	yzing Adiaba	Air-con atic mi	dition xing of	ing Pro f two m oning a	ocesses noist a
round air c	ondit	ioning					Unit	-3							

CO/ POs	PO1	PO2	боч	P04	50d	90d	20 d	80d	60d	PO10	PO11	PO12	PSO1	PSO2	EOSd
CO1	3	2/	\wedge							> /	\wedge		1	2	
CO2	3	/ 3		//									1	3	
CO3	3 <	3				/	/				\wedge		1	2	
CO4	3	2					/ <						1	2	
CO5	3	2					<u></u>						1	2	1
CO6	3	2											1	2	
Average	3	2.3											1	2.2	1

Boilers: Steam generators-classifications. Working of fire-tube and water-tube boilers, boiler mountings & accessories, air pre heater, feed water heater, super heater. Boiler efficiency. Condenser: Classification of condenser, Air leakage, Condenser performance parameters.

Unit-4

Gas Turbines : Classification of Gas turbines; Gas turbine (Brayton) cycle; description and analysis of open cycle gas turbine; Derivations of equations for efficiency, work ratio and Pressure ratio for maximum power output; actual gas turbine cycles; Numerical problems Methods to improve thermal efficiency of gas turbines

Jet Propulsion: Introduction to the principles of jet propulsion, Turbojet and turboprop engines & their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

CASE STUDIES

- 1. Develop a python programming for analyzing (drawing PV diagram) the diesel cycle.
- 2. Prepare a report on causes of boiler and mountings accidents.
- 3. Prepare a brief report on specifications of latest IC engines used latest in new vehicles.
- 4. Prepare a report on cooling load and specifications of air-condition systems used in offices or residential places.

TEXT BOOKS

- 1. P.K. Nag "Engineering Thermodynamics" Tata McGraw Hill, 6th Edition 2018.
- 2. Ganesan V, "Gas Turbines Tata McGraw Hill, 3rd Edition, 2010.
- 3. Domkundwar and Arora, "Power Plant Engineering" Dhanpat Rai & Co, 5th Edition, 2010.

REFERENCE BOOKS

1. Saravanamuttoo, H.I.H., Rogers, G.F.C. and Cohen, H., "Gas Turbine Theory" Pearson Education Limited, 5th Edition 2013.

- 2. Rajput R.K, Thermal Engineering. Lakshmi publications, 10th Edition, 2020.
- 3. R.B.Mathur and R.P.Sharma, "Internal Combustion Engines", Dhanpat Rai & Sons, 2nd Edition, 2018.
- 4. Yunus A. Cenegal and Michael A. Boles, "Thermodynamics -An Engineering Approach", Tata McGraw-Hill, 9th Edition. 2019.
- $5.\ Mahesh\ M\ Rathore, "Thermal\ Engineering", Tata\ McGraw-Hill,\ Prentice-hall\ of\ India\ Pvt.\ Ltd,\ 1^{st}\ Edition,\ 2010.$

JOURNALS/MAGAZINES:

- 1. International Journal of Heat and Mass Transfer
- 2. American Institute of Aeronautics and Astronautics

SWAYAM/NPTEL/MOOCs:

- 1. https://www.coursera.org/browse/physical-science-and-engineering/mechanical-engineering
- 2. https://www.my-mooc.com/en/categorie/mechanical-engineering
- 3. https://nptel.ac.in/cours

Course Title	9	Smart Materi	als		Cours	se Type	Soft Core		
Course Code	B20ERS511	Credits	3	3	С	lass	V Sei	mester	
	TLP	Credits	Contact	Work	Total Number of Classes		Assessment in		
	I Lr	Credits	Hours	Load					
Course	Theory	3	3	3	Per Se	emester	Weightage		
Structure	Practice	0	0	0	Theory	Practical	IA	SEE	
	Tutorial	0	0	0	THEOLY	Fractical	IA	JLL	
	Total	3	3	3	39	0	50 %	50 %	

COURSE OVERVIEW

Overview of the course is to enhance holistic development of students and improve their knowledge about the smart materials, MR, ER fluids, Biomimetics and smart actuators, advanced in smart structures, smart composites and applications of smart materials.

The objecti	BJECTIN	/ES this cou	ırse aı	re to:										
1. Under	stand	the ba	sic co	ncepts	of con	nposit	es and	cerar	nics ma	iterials,	, electi	ro-magn	etic mate	erials and
shape	memo	ry alloy	'S	fl	مام ۱۱:ما	. Da	العلم: ۱۸۷		Chunin	C	C = = = = =	d A		- ef C
2. Study	about	tne ivii	k and	EK TIUI	as, Higr	a (chr	ı vviatr .a\	ı, LOW	Strain	Smart :	Sensor	s and Ap	plication	or Smart
3 Analyz	13 101 3 2e the 9	mart a	ctuato	ors and	smart o	compo	vij Osites A	Active	Vibratio	n Cont	trol Ac	tive Shar	ne Contro	ol Passive
Vibrat	ion Co	ntrol, H	ybrid	Vibrati	ion Con	trol a	nd Self-	-Sensii	ng Piezo	electri	ic Trans	sducers,	Energy F	larvesting
Mater	ials.													
COURSE O	UTCO	VIES (CO	Os)											
After the co	omplet	ion of t	he cou	urse, th	e stude	nt wil	l be abl	e to:						
СО					Cou	rse Ou	utcome	es					POs	PSOs
CO1 App	ly the f	undam	ental	knowle	dge of	smart	materi	als, sn	nart stru	uctures	s, piezo	electric,	1	1
MR,	ER flui	ds to so	lve p	roblem	s in the	field	of med	icine a	nd engi	neerin	g.			ļ -
CO2 Iden	tify, co	ompare	and	contra	st alte	rnativ	e solut	tiòn p	rocesse	s to s	elect t	he best	1, 2	1
proc	ess of	smart a	ctuat	ors in a	utomol	biles a	nd bior	medica	i tield.		., .		, 	1
CO3	erate i	ntorma	tion t	nrough	appro	priate	tests t	to imp	rove or	revise	the d	esign of	1, 2, 3	2
sma	ogniza :	posites	d of c	nalvsis	togge	d prob	olom 4-	finitia	n of and	art etc	ucturo		1 2 2	7
Ecto	hlich	relatio	nchin	hetwo	en ma	a proc	d data	and	nderbii	ng như	sical a	rincinlos	1, 2, 3	
CO5 sma	rt com	nosite	ann	lication	s for o	orrosi	uata ion eo:	anu u ating	and sel	f-beali	ng and	i ilicipies I MFMs	1, 2, 3,4	`
proc	lucts.	iposite	, upp		5 101 (301103	1011 000	acing .	3110 301	/ /icaiii		. IVILIVIS		
Exar	nine th	e relev	ant m	ethods	and te	chniq	ues of a	advan	ces in Se	ensing	applica	ations of	1, 2, 3,4,	5 _
CO6 sma	rt sens	ors of s	tructu	ıral hea	lth mo	nitorir	ng.						, , , ,	3
BLOOM'S L	EVEL	OF THE	COUR	SE OUT	гсоме	S			/	/				
				/			Bĺ	oom's	Level			/ /		
CO	R	ememb	er	Unde	rstand		Apply		Anal	Apply Analyze Evaluate				
	'''	Remember Understand					(L3) (L4) (L5)						_	eate
		(L1)	JECTIVES es of this course are to: tand the basic concepts of composites and ceramics materials, electro-magninemory alloys bout the MR and ER fluids, High-Band Width, Low Strain Smart Sensors and Apis for Structural Health Monitoring (SHM) e the smart actuators and smart composites, Active Vibration Control, Active Shaper Control, Hybrid Vibration Control and Self-Sensing Piezoelectric Transducers, als. ITCOMES (COs) Impletion of the course, the student will be able to: Course Outcomes In the fundamental knowledge of smart materials, smart structures, piezoelectric, if fluids to solve problems in the field of medicine and engineering. If y, compare and contrast alternative solution processes to select the best ass of smart actuators in automobiles and biomedical field. Frate information through appropriate tests to improve or revise the design of composites. In the need of analysis to good problem definition of smart structures. It has relationship between measured data and underlying physical principles composites applications for corrosion coating and self-healing and MEMs acts. In the relevant methods and techniques of advances in Sensing applications of sensors of structural health monitoring. WEL OF THE COURSE OUTCOMES Bloom's Level Remember Understand Apply Analyze Evaluate (L1) (L2) (L3) (L4) (L5)									(L5)	((L6)
CO1		(L1)		/ (L	/		(L3)		(1,4	1)		(L5)		(L6)
CO1 CO2		(L1)		(L	/		(L3)		(L4	1)		(L5)		(L6)
CO1 CO2 CO3		(L1)		(1	/		(L3)		114	1)		(15)		(L6)
CO1 CO2 CO3 CO4		(L1)		(L	/		(L3)		(L4	1)		(L5)		(L6)
CO1 CO2 CO3 CO4 CO5		(L1)		(1	/		(L3)		(L4	1)		(L5)		(L6)
CO1 CO2 CO3 CO4 CO5		(L1)		(1	/		(L3) √		(L4	1)		(L5)		(L6)
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR	RTICUL	(L1) ATION	MATE	RIX	/		(L3)		\(\lambda\)	1)		(LS)		(L6)
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF	RTICUL	ATION	MATE	SIX (I	/ / /	90	(L3)	8	\(\frac{1}{\sqrt{1}}\)	010	110	ZI(10,	(L6)
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF	STICUL 2	ATION	MATE	SIX (I	2) // // Sod	904	/ / / / / /	808	600d	PO10	P011	(L5)	PS01	(L6)
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1	RTICUL 3	ATION	MATE	SIX (I	Sod	904	(L3)	804	P009	PO10	P011	(L5)	10SA 2	(L6) E OSA
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1 CO2	3 3	ATION CO 2	MATE EQ	SIX (I	Sod	90d	/ / / / Od	800	600d	PO100	P011	P012	70 C C C C C C C C C C C C C C C C C C C	(L6)
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1 CO2 CO3 CO4	3 3 3 3	ATION CO 2 2 2	MATE & & & & & & & & & & & & & & & & & & &	SIX (I	Sod	90d	(L3)	804	(L4	DO104	PO11	P012	70 CO 2 2 1 2 1 2	(L6) 80 SA
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1 CO2 CO3 CO4 CO5	3 3 3 3	(L1) ATION 2 2 2 2 3	MATE 80 1 1 1 1	SIX 400	50d	90d	/ / / / Od	800	600d	PO10	PO11	P012	70 00 20 2 2 1 2 2 1 2 1 2 2 2 1 2 2	(L6)
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1 CO2 CO3 CO4 CO5 CO6	3 3 3 3 3	(L1) ATION 2 2 2 3 2	MATE 80 1 1 1 1 1	RIX 1 1	50d	90d	(L3)	804	660d	PO104	P011	P012	70 C 2 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 2	(L6)
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1 CO2 CO3 CO4 CO5 CO6 Average	3 3 3 3 3 3	(L1) ATION 2 2 2 3 2 2.2	1 1 1 1	RIX	50 d	90d	/ / / / Od	800	660d	PO10	PO11	PO12	TO 2 2 1 2 1 2 1 1.3 2	(L6) SO
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	(L1) ATION 2 2 2 2 3 2 2.2 edium,	1 1 1 1 3-Hig	RIX	500d	90d	(L3)	804	(L4	PO10	PO11	P012	70 C 2 2 1 2 1 2 1 2 1 3 2 2 1 3 2 2 1 3 2 2 1 3 2 2 1 3 2 2 2 1 3 2 2 2 2	(L6) Solve
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	3 3 3 3 3 3 ,y, 2-M	(L1) ATION 2 2 2 3 2 2.2 edium,	1 1 1 1 3-Hig	RIX	50 d 1 1 1	90d	/ / / / Od	800	660d	PO10	PO11	PO12	TO 2 2 1 2 1 2 1 1.3 2	(L6) SO
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	3 3 3 3 3 3 ,y, 2-M	(L1) ATION 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1 1 1 1 3-Hig	RIX	50d 1	90d	/ / / / Od	804	(L4	DO104	PO11	P012	70 C 2 2 1 2 1 2 1 2 1 3 2 1 3 2	(L6) S
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO / POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	3 3 3 3 3 3 ,y, 2-M	(L1) ATION 2 2 2 3 2 2.2 edium,	1 1 1 1 3-Hig	RIX	50 d 1 1 1	90d	/ / / / Od	800	660d	PO10	PO11	PO12	TO COM 2 2 1 2 1 2 1 2 1 2 1 3	(L6) S S S S S S S S S S S S S S S S S S S
COURSE OF The objection	3 3 3 3 3 3 ,y, 2-M	(L1) ATION 2 2 2 2 2 3 2 2.2 edium,	1 1 1 1 3-Hig	RIX	50a	90d	(L3) / / / Od	804	660d	PO104	PO11	PO12	70 C 2 2 1 2 1 2 1 2 1 3 2 1 3 2	(L6)

			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		\checkmark				
CO2		< 1				
CO3			/ 4//			
CO4			/			
CO5				✓ ✓		
CO6				✓		

CO / POs	PO1	P02	PO3	P04	PO5	P06	P07	PO8	P09	PO10	PO11	P012	PS01	PS02	PSO3
CO1	3												2		
CO2	3	2											2		
CO3	3	2	1										1	2	
CO4	3	2	1										1	2	
CO5	3	3	1	1									1	2	2
CO6	3	2	1	1	1								1	2	2
Average	3	2.2	1	1	1								1.3	2	2

COURSE CONTENT

Unit-1

Overview of Smart Materials: Introduction to Smart Materials - Smart structures - classification of smart structures, common smart materials. Piezoelectric materials, piezoelectric effect, Piezoceramics, Piezopolymers, Shape memory alloys (SMAs) - Shape memory effect - Shape memory polymers, Introduction to Electro-active Materials, Electro-active Polymers, Ionic Polymer - Electro-rheological Fluids - Magneto Rhelological Fluids.

Unit-2

Smart Actuators: Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magneto-volume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control.

Unit-3

Smart composites: Review of Composite Materials, Micro and Macro-mechanics, Laminated Composites based on the Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, governing Equation of Motion. Advances in smart structures; Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials.

Unit-4

Applications: Elastic memory composites, Smart corrosion protection coatings, Self-healing materials, MEMS - MEMS Product development - Deployment devices - Molecular machines.

Sensing Applications; Piezeoelctric Strain Sensors, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM).

TEXT BOOKS

- 1. Mohsini Shahenpoor (Ed.), "Fundamentals of Smart Materials", RSC, Cambridge, UK, 2020
- 2. Chander Prakash, Sunpreet Singh, J. Paulo Davim (Ed.), Functional and Smart Materials, CRC Press, 1st Edition, 2021.
- 3. Chang Liu, "Foundation of MEMS", Pearson Education, 2nd edition, 2012.
- 4. M.V.Gandhi and B.S.Thompson, "Smart Materials and Structures", Chapmen & Hall, London, 1992.
- 5. Mel M. Schwartz, "Smart Materials", CRC Press, 1st Edition, 2009.
- 6. Donald J. Leo, "Engineering analysis of smart material systems", John Wiley & Sons, 1st Edition, 2007.

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- 1. Radhashyam Rai, "Smart Materials for Smart Living", Nova Publishers, USA, 2017.
- 2. Qun Wang (Ed.), "Smart Materials for Tissue Engineering", RSC, UK, 2017.
- 3. Johannes Michael Sinapius, Adaptronics "Smart Structures and Materials", Springer, 2020.
- 4. Anca Filimon (Ed.), "Smart Materials": Integrated Design, Engineering Approaches and Potential Applications, CRC Press, 2019.
- 5. Vijay K. Varadan, "Smart material systems and MEMS: design and development methodologies", John Wiley & Sons, 2006.
- 6. Seung- Bok Choi & Young-Min Han, "Piezoelectric actuators: control applications of smart materials", CRC Press 2010.
- 7. Kwang J. Kim & S. Tadokoro, "Electroactive polymers for robotics applications: artificial muscles and sensors", Springer, 2007

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology
- 2. https://www.sciencedirect.com/journal/journal-of-materials-science-and-technology

SWAYAM/NPTEL/MOOCs:

Course Title	Experin	nental Stress	s Analysis	5	Cour	е Туре	Soft	Core
Course Code	B20ERS512	Credits		3	С	lass	V Sei	mester
	TLP	Credits	Contact	Work	Total N	umber of	٨٠٠٥٠	sment in
	I LF	Credits	Hours	Load	Cla	isses		ghtage
Course	Theory	3	3	3	Per Se	emester	vvei	giitage
Structure	Practice	0	0	0	Thoony	Practical	10	CEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

CO	Course Outcomes	POs	PSOs
CO1	Outline the basics of experimental methods commonly used in real time problems.	1,2	1,2
CO2	Illustrate the Photo-Elasticity principles in Two-Dimensional stress analysis.	1,2	1,2
CO3	Examine the Photo-Elasticity principles in Three-Dimensional stress analysis.	1,2,3	1,2
CO4	Analyze the coating stress in the Photo-elastic Coatings.	1,2,4	1,2
CO5	Differentiate the types of brittle Coatings and Crack detection methods.	1,2	1,2
CO6	Distinguish the surface strains using Moire fringes techniques.	1,2	1,2

 https://nptel.ac.ir https://nptel.ac.ir 	n/courses/113	/102/1221020	008/							
Course Title	Fyne	rimental Stres	s Analysis		Co	urse	Tyne	1	Soft	Core
Course Code	B20ERS512	Credits	Anarysis	3		Clas	ss	+	V Sem	nester
	TLP	Credits	Contact Hours	Work Load	Tota	l Nur Class	mber of ses	Α.	Assessr Weigl	ment in
Course	Theory	3	3	3	Pei	r Sen	nester			
Structure	Tutorial	0	0	0	Theo	ry	Practical	14	Α	SEE
	Total	3	3	3	39		0	50) %	50 %
COURSE OVERVIEW	1	1						1 23		
 2. To know the fund 3. To understand the 4. To study the stres 5. To provide geome COURSE OUTCOMES After the completion	amentals of ple photo elastic ses in 2-D & 3 etric and displa S (COs)	noto elastic co technique for D photo elast cement Moire	eatings r principal lic materia e fringe te	stress n Ils by dif chnique	neasure ferent t s.	emen	t on 2-D niques.	and 3-l	D obje	cts
co	n of the course	the student	will be ab	le to:					DOs	DSO
CO Outling the h	n of the course	Course	will be ab	le to:	din rea	al tim	a proble	ms	POs	PSO:
CO CO1 Outline the b	asics of experi	Course mental metho	will be ab Outcome ods comm	le to: s only use	d in rea	al tim	e proble	ms.	POs 1,2	PSO: 1,2
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the	asics of experi Photo-Elastici Photo-Elastici	Course mental method ty principles in	will be ab Outcome ods comm n Two-Dim Three-Di	le to: s only use nensiona mension	d in rea	al tim anal	e proble ysis.	ms.	POs 1,2 1,2 1,2,3	PSOs 1,2 1,2 1,2
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the CO5	asics of experi Photo-Elasticit Photo-Elasticit Poating stress i	Course mental metho ty principles in the Photo-el	will be ab Outcome ods comm n Two-Dim Three-Di lastic Coa	le to: s only use nensiona mension tings.	d in real stress	al tim anal	e proble ysis.	ms.	POs 1,2 1,2 1,2,3 1,2,4	PSOs 1,2 1,2 1,2 1,2
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate	asics of experi Photo-Elastici Photo-Elasticit oating stress i the types of b	Course mental method ty principles in the Photo-elittle Coatings	will be ab Outcome ods comm n Two-Dim Three-Di lastic Coan	le to: s only use nensiona mension tings. k detect	d in real stress al stression met	al tim anal s ana	e proble ysis. alysis.	ms.	POs 1,2 1,2 1,2,3 1,2,4 1,2	PSOs 1,2 1,2 1,2 1,2 1,2
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish the BLOOM'S LEVELOF	asics of experi Photo-Elasticit Photo-Elasticit oating stress i the types of b ne surface stra	Course mental metho ty principles in the Photo-el rittle Coatings ins using Moir	will be ab Outcome ods comm Two-Dim Three-Di lastic Coat and Crac re fringes	le to: s only use nensiona mension tings. k detecti	d in real stress al stress ion met	al tim anal ss ana	e proble ysis. alysis.	ms,	POs 1,2 1,2,3 1,2,4 1,2,4 1,2	1,2 1,2 1,2 1,2 1,2 1,2
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish the BLOOM'S LEVELOF T	asics of experi Photo-Elastici Photo-Elasticit oating stress i the types of b he surface stra THECOURSE O	Course mental metho ty principles in the Photo-e rittle Coatings ins using Moir UTCOMES	will be ab Outcome ods comm Three-Di lastic Coan and Crac e fringes	le to: s only use nensiona mension cings. k detecti cechniqu	d in real stress al stress al stress evel	anal sanaachods	e proble ysis. alysis.	ms.	POs 1,2 1,2 1,2,3 1,2,4 1,2	PSOs 1,2 1,2 1,2 1,2 1,2 1,2
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish th BLOOM'S LEVELOF T CO Rem	asics of experiphoto-Elasticite coating stress in the types of both the surface strace	Course mental metho ty principles in the Photo-e rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm Two-Dim Three-Di lastic Coan and Crac re fringes Blo Apply (L3)	le to: s only use nensiona mension tings. k detecti techniqu	d in real stress al stress al stress evel Analyz (L4)	anal timmanal sana anal sana ana sana ana sana ana sana ana sana ana	e proble ysis. alysis. Eval	ms.	POs 1,2 1,2,3 1,2,4 1,2	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 1,2
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish th BLOOM'S LEVELOF T CO Rem CO1	asics of experi Photo-Elasticit Photo-Elasticit coating stress i the types of b ne surface stra FHECOURSE O nember (L1)	Course mental metho ty principles in the Photo-el rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm Two-Dim Three-Di lastic Coat and Crac re fringes Apply (L3)	le to: s only use nension mension cings. k detecti cechniqu	d in real stress al stress al stress evel Analyz (L4)	analis ana	e proble ysis. alysis. Eval	ms. uate .5)	POs 1,2 1,2,3 1,2,4 1,2 1,2	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 Create (L6)
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CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish th BLOOM'S LEVELOF T CO Rem CO1 CO2 CO3	asics of experi Photo-Elastici Photo-Elasticit coating stress i the types of b he surface stra THECOURSE O	c, the student Course mental method ty principles in the Photo-el rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm Three-Di lastic Coat and Crac e fringes Ble Apply (L3)	le to: s only use nensiona mension tings. k detecti techniqu	d in real stress al stress al stress evel Analyz (L4)	analis ana	e proble ysis. alysis. Eval	uate (5)	POs 1,2 1,2,3 1,2,4 1,2 1,2	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 Create (L6)
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish th BLOOM'S LEVELOF T CO Rem CO1 CO2 CO3 CO4	asics of experion of the course asics of experion Photo-Elasticit Photo-Elasticit coating stress in the types of both the surface strace strace strace as a surface as a surface strace as	c, the student Course mental metho ty principles in the Photo-el rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm Three-Di lastic Coat and Crac re fringes Apply (L3)	le to: s only use nensiona mension tings. k detecti techniqu	d in real stress al stress al stress.	analis ana	e proble ysis. alysis. Eval	ms. uate .5)	POs 1,2 1,2,3 1,2,4 1,2 1,2	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 Create (L6)
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish th BLOOM'S LEVELOF T CO Rem CO1 CO2 CO3 CO4 CO5	asics of experi Photo-Elastici Photo-Elasticit coating stress i the types of b he surface stra THECOURSE O	Course mental metho ty principles in the Photo-el rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm Three-Di lastic Coan and Crac re fringes Apply (L3)	le to: s only use nensiona mension sings. k detecti cechniqu	d in real stress al stress al stress evel Analyz (L4)	anal tim anal thods	e proble ysis. alysis. Eval	uate .5)	POs 1,2 1,2,3 1,2,4 1,2 1,2	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 Create (L6)
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish th BLOOM'S LEVELOF T CO Rem CO1 CO2 CO3 CO4 CO5 CO6	asics of experi Photo-Elastici Photo-Elasticit coating stress i the types of b he surface stra THECOURSE O	c, the student Course mental metho ty principles in the Photo-el rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm of Two-Dim of Three-Di lastic Coat and Crac e fringes Apply (L3)	le to: s only use nensiona mension tings. k detecti techniqu	d in real stress al stress al stress evel Analyz (L4)	analis ana	e proble ysis. alysis. Eval	ms.	POs 1,2 1,2,3 1,2,4 1,2 1,2	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 Create (L6)
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish th BLOOM'S LEVELOF T CO Rem CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTICULAT	asics of experi Photo-Elastici Photo-Elastici coating stress i the types of b ne surface stra THECOURSE O nember (L1) TONMATRIX	c, the student Course mental metho ty principles in the Photo-el rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm of Two-Dim of Three-Di lastic Coat and Crac re fringes Apply (L3)	le to: s only use nensiona mension cings. k detecti cechniqu	d in real stress al stress al stres evel Analyz (L4)	anal time anal thods	e proble ysis. alysis. Eval (I	uate .5)	POs 1,2 1,2,3 1,2,4 1,2 1,2	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 Create (L6)
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish th BLOOM'S LEVELOF T CO Rem CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTICULAT	asics of experiphoto-Elasticite the types of better the surface stratement (L1) TIONMATRIX	c, the student Course mental method ty principles in the Photo-el rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm Three-Di lastic Coan and Crac re fringes Apply (L3)	le to: s only use nensiona mension cings. k detecti cechniqu	d in real stress al stress al stres less. Analyz (L4)	anal timm anal s ana chods	e proble ysis. alysis. (I	uate .5)	POs 1,2 1,2,3 1,2,4 1,2 1,2	PSOs 1,2 1,2 1,2 1,2 1,2 Create (L6)
CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish th BLOOM'S LEVELOF T CO Rem CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTICULAT CO/ POS CO1 3	asics of experiphoto-Elasticity coating stress in the types of both the surface strace	c, the student Course mental metho ty principles in the Photo-el rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm Three-Di lastic Coal and Crac re fringes Apply (L3)	le to: s only use nensiona mension tings. k detecti techniqu	d in real stress al stress al stress less.	orthods chods	e proble ysis. alysis. Eval (I	uate 5)	POs 1,2 1,2,3 1,2,4 1,2 1,2 3 3	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 1,2 2 1,2 2 2 2
1. https://nptel.ac.ir 2. https://nptel.ac.ir Course Title Course Code Course Structure COURSE OVERVIEW Experimental Stress through experiment Rosettes, Photo-Elas & Brittle Coatings, a COURSE OBJECTIVE: 1. To study the work 2. To know the fund 3. To understand the 4. To study the stress 5. To provide geome COURSE OUTCOME: After the completion CO CO1 Outline the b CO2 Illustrate the CO3 Examine the CO4 Analyze the c CO5 Differentiate CO6 Distinguish the BLOOM'S LEVELOF T CO Rem CO1 CO2 CO3 CO4 CO5 CO6 CO4 CO5 CO6 COCOSE ARTICULAT CO/ POS CO3 CO4 CO5 CO6 COCOSE ARTICULAT CO/ POS CO6 COCOSE ARTICULAT CO/ POS CO6 COCOSE ARTICULAT CO/ POS CO7	asics of experiphoto-Elasticity coating stress in the types of both the surface stratement (L1) TIONMATRIX 2 3	c, the student Course mental method ty principles in the Photo-el rittle Coatings ins using Moir UTCOMES Inderstand (L2)	will be ab Outcome ods comm Three-Di lastic Coat and Crac re fringes Apply (L3)	le to: s only use nensiona mension cings. k detecti cechniqu	d in real stress al stress al stres les. Analyz (L4)	anal timm anal s ana chods	e proble ysis. alysis. (I	uate .5)	POs 1,2 1,2,3 1,2,4 1,2 1,2 3 3 3	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 Create (L6)

CO/ POs	PO1	P02	PO3	P04	PO5	90 <i>a</i>	P07	P08	60d	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	2											3	2	
CO2	3	3											3	3	
CO3	3	3	1										3	2	

CO4	3	2		1					3	3	
CO5	3	3							3	3	
CO6	3	2							3	2	
Average	3	2.5	1	1					3	2.5	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Electrical Strain Gauges: Strain sensitivity in metallic alloys, Gage construction, Adhesives and mounting techniques, Gage sensitivity and gage factor, Performance Characteristics, Environmental effects, Strain Gage circuits. Potentiometer, Wheat stone's bridges.

Strain Rosettes: Two element, three element rectangular and delta rosettes, Correction for transverse strain effects, Stress gage, Plane shear gage, and Stress intensity factor gage.

Unit-2

Photo-Elasticity: Nature of light, Wave theory of light - optical interference, Stress optic law – effect of stressed model in plane and circular polariscopes, Isoclinics & Isochromatic, Fringe order determination Fringe multiplication techniques.

Two Dimensional Photo-elasticity: Separation methods: Shear difference method, Analytical separation methods, Model to prototype scaling, Properties of 2D photo-elastic model materials, materials for 2D photo elasticity.

Unit-3

Three-Dimensional Photo elasticity: Stress freezing method, scattered light photoelasticity, scattered light as an interior analyzer and polarizer, Scattered light Polari scope and stress data Analyses.

Photo-elastic (Bi-fringe) Coatings: Birefringence coating stresses, Effects of coating thickness: Reinforcing effects, Poisson's, Stress separation techniques: Oblique incidence, Strip coatings.

Unit-4

Brittle Coatings: Coatings stresses, Crack patterns, Refrigeration techniques, Load relaxation techniques, Crack detection methods, Types of brittle coatings, Calibration of coating. Advantages and brittle coating applications. **Moire Methods:** Moire fringes produced by mechanical interference. Geometrical approach, Displacement field approach to Moire fringe analysis, out of plane displacement measurements, Out of plane slope measurements. Applications and advantages.

CASE STUDIES

- 1. Determine the different types of stresses acting on a motorcycle handle using strain gauges.
- 2. Determine the stress distribution in a rectangular plate with rectangular cut out using photoelasticity.
- 3. Using Moire method determine the deformation in thin sheet metals.

TEXT BOOKS

- 1. Dally J W and Riley W F, "Experimental Stress Analysis", McGraw Hill Inc New York, 2014.
- 2. Sadhu Singh, "Experimental Stress Analysis", Khanna Publisher New Delhi, 2009.
- 3. Srinath L.S., "Experimental stress Analysis", Tata McGraw Hill, New Delhi, 1984.

REFERENCE BOOKS

- 1. Jindal, "Experimental stress analysis", Pearson Publishers, 2018.
- 2. J.Srinivas, "Stress analysis-An introduction to Experimental Techniques", Narosa Publishers, 2015.
- 3. Mubin Khanna, "Experimental Stress Analysis", 2003.
- 4. Freddi, Olmi, Cristofolini, "Experimental stress analysis for materials and structures", Springer, 2015

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/topics/engineering/experimental-stress-analysis

Course Title	En	ergy Techno	logy		Cours	se Type	Sof	t Core
Course Code	B20ERS513	Credits	:	3	С	lass	V sei	mester
	TLP	Credits	Contact	Work	Total N	umber of	٨٥٥٥٥	sment in
	ILF	Credits	Hours	Load	Cla	asses		ghtage
Course	Theory	3	3	3	Per Se	emester	vvei	giitage
Structure	Practice	0	0	0	Thooma	Dractical	10	CEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

2. https://link.spring	er.com/book,	/10.1007/97	8-3-319-060	86-6				
SWAYAM/NPTEL/M	OOCs:							
1. https://onlinecour	rses.nptel.ac.i	n/noc21_me	e02/preview	'				
2. https://nptel.ac.in	courses/112	106068						
	T							_
Course Title		Energy Tech	nology		Cours	se Туре	Soft	Core
Course Code	B20ERS513	Credits	Cantast	\A/==d.	T-+-I N	lass	V sen	nester
	TLP	Credits	Contact	work	Iotal N	umber of	Assess	ment in
Course	Theory	2	2	2	Dor Se	mester	Weig	htage
Structure	Practice	0	0	<u> </u>	rei se	inester		
Structure	Tutorial	0	0	<u> </u>	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %
COURSE OVERVIEWS	:						,0	
This course explores	the concent	of thermal 4	enerøy conv	ersion	also introd	luces the di	ifferent tyr	es of fuels
used for stoom good	ration and or	uinment for	hurning	al in lun	an form T	his course in	troduces +	o hio mass
energy and its charge	rtarictics It al	so emphasia	es on conve	ui iii iuli rsion of	various his	mass energ	v into solid	CCDIII UIU U.
gaseous forms Eurth	ner the course	a dealcarith	conversion o	of hioma	cc into mo	thanal atha	nol biogas	hio diesel
etr	iei die course	. acais Willi (JOHNEI SIOH (יי אוטווומ	33 1110 1116	manol, Ellid	noi, biogas	י, הוט עובאצו
COLIRSE ORIECTIVES	•							
1 To understand en	ergy scenario	energy cour	res and the	ir utiliza	tion			
2. To gain the knowle	edge about di	iesel engine i	nower nlant	ii utiliza	tion			
3. To enhance the kn	nowledge about u	ut renewahl	a anargy sol	ircec				
4. To enable the stud	lents to gain t	the knowled	ge on hydro	gen ene	rgy genera	tion /		
COURSE OUTCOMES	s (COs)	the knowleds	ge on riyaro	gen ene	rgy genera	10112		
After the completion	of the cours	a the studer	nt will he ah	le to:				
CO COMPLETION	Tor the cours	c, the studen	Out oc ab		<u> </u>		/ no-	DCO-
CO Communication the		Course	Outcomes				POS	PSUS
CO1 Summarize th	ie basic conce	pts of therm	al energy sy	stems a	na identiry	coanand asi	n 1	1
CO2 Identify renev	wahla anaray	rosources an	piaiits.	zation	\		167	1
Discuss the p	rinciples of or	oray convor	cion of win	d gooth	ormal occ	an hiomass	1,0,7	1 2
CO3 Discuss the pi	orgy systems	leigy conver	Sion of will	u, geotii	ermai, oce	an, Diomass	5, 1,0,7	1,2
CO4 Describe the	mothods used	t to gonorate	Llydrogon	on oran	_/		1 7	1
Describe the	main char	actoristics o	f renewah	o oper		s and thai	1, /	1
CO5 Comparison 4	vith fossil fuol	sciensuits 0	i renewab		_Б у зоитсе	s anu tilel	1,0,7	1
CO6 Investigate th	e decian nara	meters of hi	ogas digosts				1 2 2 7	1 7 2
BLOOM'S LEVELOFT	HECULIDEE O	HITCOMEC	ogas uigeste	.13.			1,2,3,7	1,2,3
	. ILCOUNSE O	O I COIVILS	RI.	om's L	vel			
CO Rem	ember II	nderstand	Annly	- J J EC	Analyze	Fvalue	ate	Create
	L1)	(L2)	(L3)		(L4)	(L5)	, -	(L6)
CO1	•	√	(/		. ,	(-5)	•	,
CO2		√ ·						
CO3		•	V					
CO4		V	•					
CO5		, √						
CO6		٧			V			
500					٧			
2. https://link.spring SWAYAM/NPTEL/M 1. https://onlinecour 2. https://nptel.ac.in Course Title Course Code Course Structure COURSE OVERVIEW: This course explores used for steam gene energy and its charac gaseous forms. Furth etc. COURSE OBJECTIVES 1. To understand ene 2. To gain the knowle 3. To enhance the kn 4. To enable the stuce COURSE OUTCOMES After the completion CO CO1 Summarize the handling syste CO2 Identify reneved and biogas ene CO4 Describe the comparison we CO5 Describe the comparison we CO6 Investigate the CO7 CO1 CO2 CO3 CO4 CO5 CO6 Rem (CO7 CO6 CO6 Ref: BOS/SME/BME-2020								

			Bloom	ı's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		V				
CO2		V				
CO3			$\sqrt{}$			
CO4		V				
CO5		V				
CO6				V		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	90d	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3												3		
CO2	3					2	2						3		
CO3	3	2				2	2						3	2	
CO4	3						1						3		
CO5	3					2	1						3		
CO6	3	2	1										3	1	1
Average	3	2	1			2	1.5						3	1.5	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Thermal Energy Conversion System: Review of energy scenario in India, General Philosophy and need of Energy, Different Types of Fuels used for steam generation, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace,

Coal and Ash Handling: Chimneys: Natural, forced, induced and balanced draft, Cooling towers and Ponds

Unit-2

Diesel Engine Power System: Applications of Diesel Engines in Power field. Method of starting Diesel engines. Auxiliaries like cooling and lubrication system, filters, centrifuges, Oil heaters, intake and exhaust system, Layout of diesel power plant.

Solar Energy and Applications: Solar radiation - Availability- Measurement and estimation- Solar radiation geometry

Hydrogen Energy: Introduction to hydrogen energy, methods of hydrogen production (electrolytic and thermo chemical method).

ال.Unit-3

Wind Energy: Wind energy - General considerations - Wind Power plant design – Horizontal axis wind turbine **Tidal Power:** Power generation using OTEC - Wave and Tidal energy - Scope and economics - Limitations.

Hydro-Electric Energy: General layout of hydel power plants, Hydrographs, flow duration and mass curves and numerical. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves.

Unit-4

Biomass Energy Sources: Biomass production for energy farming, origin of Biomass-Photosynthesis process, Energy through fermentation -Ethanol Production from sugarcane and starch, Biomass characteristics.

Bio-Methanization: Anaerobic digestion, Basic principles, factors affecting biogas yield, biogas digester (floating gas holder and fixed dome type with working principle and diagram).

Geothermal Energy Conversion: Availability - Geographical distribution.

CASE STUDIES

- 1. Prepare the report on Thermal power plants in INDIA.
- 2. Prepare the report on Diesel and Hydel power plants in Karnataka.
- 3. Study on Wind Energy distribution/resources across Karnataka.
- 4. Parameters to be considered foe site selection of hydroelectric power plant.

TEXT BOOKS

- 1. P.K Nag, "Power Plant Engineering", Tata McGraw Hill, 4th Edition, 2017.
- 2. Morse F.T "Power Plant Engineering", Van Nostrand Reinholdire, 3rd Edition, 1953.
- 3. B H Khan, "Non-conventional energy resources", McGraw Hill Education, 3rd Edition, 2017.
- 4. A. W. Culp Jr, "Principles of Energy conversion", McGraw Hill, 2nd Edition, 2000.

Course Title	Auto	motive Engir	eering		Cours	е Туре	Soft	Core
Course Code	B20ERS514	Credits	3		C	lass	V ser	mester
	TLP	Credits	Contact Hours	Work Load	\ '	umber of isses		sment in
Course	Theory	3	3	3	Per Se	emester	VVCIE	giitage
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	vilediy	Fractical)	JLL
	Total	/ /3 <	3 /	/3	39 /	<u></u>	50 %	50 %

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REFERENCE BOOK	(S	McGrave IIII	1000					
Stanier, "Plant Domakundawa	r. "Power Plant Fn	gineering"	i, 1998. Dhannath i	Rai & Co). 5 th Editio	on. 2008		
3. S.P. Sukhatme.	"Solar Energy: pr	inciples of T	hermal Co	ollection	and Stora	, 2000 ige", Tata M	cGraw-Hill.	, 3 rd Edition.
2009.		F 22 0. 1				J , .232 14	- ·- ·····)	,
4. L.L. Freris, "Wir	nd Energy Convers	ion Systems	", Prentice	Hall, 19	90.			
JOURNALS/MAG	AZINES							
1. https://www.sc	ciencedirect.com/t	topics/engin	eering/ash	n-handliı Survov	ng-plant	n nouver al	anta drivar	a bu diasal
and gas engi	isearchgale.hel/pu ines	ibiication/20	0/838340_	_Survey_	_oi_moder	n_power_pi	ants_unver	n_by_diesei
3. https://www.jc	ournals.elsevier.co	m/internation	onal-journa	al-of-hyc	drogen-en	ergy		
4. https://www.so	ciencedirect.com/s	science/artic	:le/pii/S22	11467X1	19300379	<i>3,</i>		
SWAYAM/NPTEL,	/MOOCs:							
1. https://onlinec	ourses.nptel.ac.in/	/noc21_me8	36/preview	<u> </u>				
2. https://nptel.ac	c.in/courses/1031(07157 /pos21_s\11	1 /provisor					
4 https://onlinec	ourses.nptei.ac.in/ ourses notel ac in/	/noc21_cn1. /noc22_ch2:	1/preview					
	, , , , , , , , , , , , , , , , , , ,		7					
Course Title	Auto	motive Eng	ineering		Cour	se Type	Soft	Core
Course Code	B20ERS514	Credits	Contact	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	Tatal	lass	V sen	nester
	TLP	Credits	Hours	NOKK	Lotal N	asses	Assessr	ment in
Course	Theory	3	3	3	Per Se	emester	Weig	htage
Structure	Practice	0	0	0	1		$\overline{}$	
	Tutorial	0	10	$\sqrt{0}$	Theory	Practical	IA	SEE
			/ -				/	1
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COURSE OVERVIE This course deals and fuel supply sy and methods of co advance ignition sy COURSE OBJECTI 1. To understand 2. To explore fund 3. To explain the i 4. To recognize the COURSE OUTCON After the complete	with the compone system. It emphasizes ontrolling emission systems, steering a VES the construction a ctions of electrical importance of emine need for safety a MES (COs)	ents used in zes on emissions. This course and brake sy components ssion control and comfort the student	automotivisions, emit se explores stem to co of compor s used in Igol, alternation in automotivis will be ab	ye like, eting from sthe next use gnition stee fuels a obiles.	engine tra n various cessity of c e vehicles. ed in petro ystem of a and engine	nsmission sy types of veh cooling and le ol and diesel an automobil modification	50 % estem, brakicles, emissubricating semines. engines. e. ns for alterr	ing system sion norms system, the
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REFERENCE BOOM 1. Stanier, "Plant 2. Domakundawa 3. S.P. Sukhatme, 2009. 4. L.L. Freris, "Wir JOURNALS/MAG/ 1. https://www.sc 2.https://www.sc 3. https://www.sc SWAYAM/NPTEL, 1. https://onlinec 2. https://onlinec 2. https://onlinec 4. https://onlinec 4. https://onlinec Course Title Course Code Course Title Course Code Course Geals and fuel supply sy and methods of co advance ignition sy course Objecti 1. To understand 2. To explore func 3. To explain the i 4. To recognize th COURSE OUTCON After the complet CO CO1 Describe to lubrication CO2 Illustrate to CO3 for sustain CO4 forced indu CO5 Illustrate to CO5 CO1 CO1 CO1 CO1 CO2 CO3 CO4 CO4 CO5 CO5 CO5 CO6 CO5 CO6 CO6 CO7	with the component system. It emphasizes on trolling emission systems, steering at the construction at the construction at the construction of the course, the construction at systems the working of automatic different types of the construction at	ents used in res on emissions. This course on emission control and comfort the student Course Course of Ignition sy and working engine emison of Ignition sy and working components.	automotivisions, emit se explores stem to co of compores used in legal, alternate in automotivisions, its constitution of transport of the constitution of the constit	ye like, eting from sthe necessary the necessary the second state of the second stems are control and in automatical states.	any various cessity of ce vehicles. ed in petro ystem of a nd engine en	nsmission sy types of veh cooling and line automobil modification cooling an mitations ion standard and interpress as and their	stem, braki icles, emiss ubricating subricating subrications for alternative subrications sub	ing system sion norms system, the system, the system of th

ſ	CO6	Recognize the different types of suspension systems, Steering systems, braking	1	1
	COB	systems and describe their working principles.	1	1

Recognize the different types of suspensic systems and describe their working principl BLOOM'S LEVELOF THECOURSE OUTCOMES CO Remember Understand (L1) (L2) CO1	Bloom's I Apply (L3) Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q	Level Analyz (L4)	0010d	Ev	Paluate (L5)	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Crea (L6	80SA
CO Remember (L1) (L2) CO1 CO2 CO3 CO4 CO5 CO6 CO6 CO6 CO7 COC CO6 CO7 COC CO6 COC	Apply (L3) One of the second	Analyz (L4)	/ze)	P011	aluate (L5)	705a 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Crea (L6	80 <u>8</u>
(L1) (L2) CO1	(L3) Compared to the second s	(L4)	PO10	P011	P012	1 1 1 1 1 1	PS02	E)
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COURSE ARTICULATIONMATRIX CO/ POs	2 2 Unit-1 urk Ignition (SI) Piston, conne	60d	PO10	P011	P012	1 1 1 1 1 1	PS02	PSO3
COURSE ARTICULATIONMATRIX CO/ POS	2 2 Unit-1 urk Ignition (SI) Piston, conne	60d	P010	P011	P012	1 1 1 1 1 1	PSO2	PSO3
COURSE ARTICULATIONMATRIX CO/ POS	2 2 Unit-1 urk Ignition (SI) Piston, conne	60d	PO10	P011	P012	1 1 1 1 1 1 1	PS02	PS03
CO/ POS	2 2 Unit-1 urk Ignition (SI) Piston, conne	800d	P010	P011	P012	1 1 1 1 1 1	PS02	PSO3
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Fuel Supply System: Fuel supply in SI engines- Fusimple carburetors, Injection systems -Single-point pump, Common rail, fuel injection pumps and injection pumps and injection emissions and Control Systems: Autom Controlling evaporative emissions, Cleaning the ecombustion process, Exhaust gas recirculation, Catalana Systems Systems and Turbook	Unit-2 el mixture requit body injection ctors. notive emission exhaust gas, Contalytic converte unit-3	quirement on, mult on control ontrolling er, Emiss	nts for itipoint rols, C ng the ssion st	SI eng t fuel i Control air-fue candard	gines, Vinjection	Workir on, Inli rankca ture, C	ng prin ne dist se em Controll	ciple of tributonission ling th
Comparison between Battery and Magneto Ignition Systems, Advantages of Electronic Ignition Systems of superchargers, Turbocharger and comparisons. Transmission System: General arrangement of cluf flywheel, Single plate, multi-plate and centrifugal of Gear Box: Necessity for gear ratios in transmission	n System, Draw , Types of Elect utch, Principle clutches. I. Self-study: sy	vbacks (E tronic Ig of friction	Disadva gnition ion clu	santage Syster atches,	ignit es) of C m, Ford Torqu xes.	Conven ced Inc	itional duction	Ignitic Ignitic In, Type

CO/ POs	PO1	PO2	PO3	P04	PO5	90d	P07	80d	P09	PO10	PO11	PO12	PS01	PS02	PSO3
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CO2	3			/	/	\wedge	//						1		
CO3	3					2	/ 2	2					1		
CO4	3	1											1		
CO5	3												1		
CO6	3												1		
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suspension for fro	nt wheel and rea	r wheel. Air	suspension	n system.	. Types of I	orakes, mecl	nanical cor	mpressed air,	
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3. To dem	onstra	te the a	ability	to desi	gn and i	impler	nent th	nese to	ols.						
4. Develo	o strate	gies fo	r cond	ucting	design	of exp	erimen	nts in p	rocess i	improv	ement	5.			
5. Perforn	n Reliak	oility ev	/aluati	on of N	1echani	cal, El	ectrica	l, Elect	ronics a	and Sof	tware ⁻	Гесhno	logy Sy	stems	5.
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co	Jonnpie	tion or	the co	urse, tr	Cours	se Out	comes	ic to.					POs		PSOs
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CO1	techn	ology a	ınd ma	nagem	ent.								1,2		1,2
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655	Perfor	m ana	lysis of	f proces	ss capal	bility a	nd reli	ability	aspects	s of pro	ductio	n , .	-,-		_,_
CO5	proce	sses.	•			^		/-1	^			1,2	,3,9,10		1,2
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principles	of conf	trol ch	arts. ch	noice o	f contro	ol limit	ts, sam	ple siz	e and s	amplin	g freni	iencv. i	rational	suh	groun
Analysis o	f patter	ns of c	ontrol	charts.			-, 56111	512			J 546				 -
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			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
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CO2		\/\v\				
CO3		V				>
CO4		N/		\ \ \ \ / /		
CO5						
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CO/ POs	PO1	P02	PO3	P04	PO5	PO6	P07	P08	P09	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2											1	2	
CO2	3	2	1				\wedge		<u>/2</u>				1	3	
CO3	3	2	1						2				1	3	
CO4	3	2	2						2				1	3	
CO5	2	2	2										1	3	
CO6	3	3			1				2	1			1	3	
Average	2.8	2	1		1				2				1	2.8	

	crol Charts for Variable and Attribute Data standard deviation. Controls chart for fraction or mities (c and u charts). ess capability: Methods of estimating process capability: Methods of estimating process anced Control Charts: Control charts for Indiang average, Group control charts eptance Sampling: Lot by lot sampling – type iniques – O.C. curves – producer's Risk and its for AQL and LTPD- uses of standard samples of core rate curve, types of failure, reliability evasories-parallel device configurations. Reliable eliability – redundancy unit and standby recorded designs (CRD), Randomized block		
		Unit-2	
Cont	rol Charts for Variable and Attribute Data	: Controls charts for mean and Rang	ge, Control charts for mean
and:	standard deviation. Controls chart for fracti	ion non- conforming (p, np, 100p cha	arts), Control chart for non-
Proc	ess canability: Methods of estimating proc	ess canability Process canability ind	lices- cn and cnk
1100	estimating proc	Unit-3	inces op and opk
Adva	anced Control Charts: Control charts for Ind	lividual measurements, Cumulative s	sum, exponentially weighted
mov	ing average, Group control charts		
Acce	ptance Sampling: Lot by lot sampling – type	es – probability of acceptance in singl	e, double, multiple sampling
tech	niques – O.C. curves – producer's Risk and (Consumer's Risk. AQL, LTPD, AOQL o	concepts- standard sampling
piani	s for AQL and LTPD- uses or standard sample	illig pialis.	
		Unit-4	
Relia	ibility and Life Testing: Failure models of co	omponents, definition of reliability,	MTBF, Failure rate, common
failu	re rate curve, types of failure, reliability eva	aluation in simple cases of exponent	tial failures in series, parallel
and	series-parallel device configurations. Reliab	oility improvements – techniques- us	e of Pareto analysis – design
tor r	eliability – redundancy unit and standby red	dundancy, Product life cycle. Conoral model of a process. Evamp	les of designed experiments
in n	rocess improvement. Principles of experi	mentation. Guidelines for designing	g experiments. Completely
rand	omized designs (CRD), Randomized block d	lesigns (RBD), Factorial experiments	– 22 design
			C
Simu	lation on Statistical tool (only for Assignm	nent)	
SI. P	Title of the Experiment	Tools and	Expected Skill
	Construction and interpretation of statis	stical control	Ability
1.	charts a. X-bar & R-chart b. X-bar & s-cha	rt.c. np-chart Minitab software	Hands on Experience
	d. p-chart e. c-chart f. u-chart		
	Single sample inspection plan: Const	ruction and Minitab software	
2.	interpretation of OC, AQL, LTPD, ASN	I, ATI, AOQ,	Hands on Experience
3	Calculation of process canability	Minitah software	Hands on Evnerience
	Calculation of process capability	wiintab software	rianus on Experience
CASI	STUDIES		
1. Aŗ	oplication of SQC in packaging Industry		
2. lm	plementation of SQC and Fuzzy failure mod	de and effect analysis in various auto	omobile and manufacturing
Se 3	ctor-A case study review.	4	
3. AS	sessing the Quality of product using SQC iv	laps: A Case study	
TEXT	BOOKS		
1. Gr	ant, Eugene .L, "Statistical Quality Control"	', McGraw-Hill, 7 th Edition, 2006.	
2. L.	S.Srinath, "Reliability Engineering", Affiliate	ed East west press, 4 th Edition, 2009.	
3. M	ahajan, "Statistical Quality Control", Dhanp	oat Rai, 2016.	
	.KENCE BOOKS onohar Mahaian "Statistical Quality Control	ol" Dhannat Pai & Conc. 2001	
REFE	ononar manajan, Statistical Quality Control C.Gupta. "Statistical Quality Control" Khan	or , Drianpat Kar & 30115, 2001. Ina Publishers. 6th Edition India 200	03.
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REFI 1. M 2. R. 3. Be 4. Sh JOUI 1. IE	charts a. X-bar & R-chart b. X-bar & s-chard d. p-chart e. c-chart f. u-chart Single sample inspection plan: Constinterpretation of OC, AQL, LTPD, ASN AOQL curves Calculation of process capability ESTUDIES Oplication of SQC in packaging Industry plementation of SQC and Fuzzy failure mode ector-A case study review. Seessing the Quality of product using SQC Macy in MSME'S/SME'S: A case study FBOOKS Fant, Eugene .L, "Statistical Quality Control" (5. Srinath, "Reliability Engineering", Affiliate ahajan, "Statistical Quality Control", Dhanp (5. Srinath, "Statistical Quality Control", Khan esterfield D.H Quality Control, New Jersey, Floarma S.C., "Inspection Quality Control and RNALS/MAGAZINES EE Transactions on Industrial Informatics FOS/SME/BME-2020-21-20.06.20/2021-22-05.06.21/2	Reliability", Khanna Publishers, 200 2022-23-25.06.22/2023-24-10.06.23	

Course Title	S	mart Materi	als		Cour	е Туре	Open Elective		
Course Code	B20MEO501	Credits		3	С	lass	V Se	mester	
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in	
Course	Theory	3 /	3	3 ^	Per Se	emester	weig	ghtage	
Structure	Practice	0	0	0	Theory	Practical	IA	SEE	
	Tutorial	/ 0 /	0 /	0 \	THEOLY	Tractical	iA.	JLL	
	Total	3	3	3	39	0	50 %	50 %	

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2. International jou	urnal of Productio	n Research						
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6. Journal of Manu	facturing Techno	logy Manage	ment					
7. Journal of Produ	ict Innovation Ma	nagement						
8. Reliability Engine	eering & System S	Safety						
SWAYAM/NPTEL/N	MOOCs:							
1. https://nptel.ac.i	in/courses/11010	15088 Vatatiatian Lau			,			
3. https://www.ude	emy.com/course/ emv.com/course/	'statisticai-qi 'mastering-si	uality-con tatistical-	itroi-sqc, aualitv-c	/ control-wit	th-minitab/		
Course Title	S	mart Materi	ials		Cours	se Type	Open E	lective
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	Total	3	3	/3	39	0	50 %	50 %
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2. Study about the Sensors for Struct 3. Analyze the smart comports of Sensors for Struct 3. Analyze the smart comports of Sensors for Struct 1. Apply the furth of Sensors of S	e MR and ER fluid ctural Health Mor art actuators and ol, Hybrid Vibrati ES (COs) on of the course, to indamental know is to solve probler impare and conti- mart actuators in formation through osites. The need of analysic relationship betwo posites applications of structural health of the relevant method	ds, High-Ban nitoring (SHN smart compon Control a he student velocities and technical to good proveen measures for corrects and technical the monitorial control and technical the control and tech	d Width, A) osites, Ac and Self-S vill be abl Outcome rt materi d of medi cive solut s and bior te tests t oblem de red data osion coa iques of a ring.	Low Streetive Vibsensing I	ration Cor Piezoelect rt structur d engineer cesses to field. ve or revi	estro-magne Sensors an Active ric Transduct es, piezoelect ing. select the se the design tructures. hysical prince alling and Magnetication	POsetric, 1 best 1, 2 in of 1, 2, 3 EMs Title materials Posetric, 1 best 1, 2 1, 2, 3 1, 2, 3 1, 2, 3	s and shape on of Smart trol, Passive Harvesting S PSOs 1 1 3 2 3 2 3,4 3 4,5 3
COURSE OBJECTIVE The objectives of the 1. Understand the 1 memory alloys 2. Study about the Sensors for Struct 3. Analyze the smath Vibration Control Materials. COURSE OUTCOM After the completion CO CO1 Apply the furill MR, ER fluids Identify, corprocess of smart comports CO3 Generate interproducts. CO4 Recognize the Establish are CO5 Smart comports CO6 Examine the smart sensor	e MR and ER fluid ctural Health Morart actuators and pol, Hybrid Vibration of the course, to make the course of th	ds, High-Ban nitoring (SHN smart compon Control a he student velocities and technical to good proveen measures for correct ds and technical the monitorial control of the student velocities and technical the monitorial control of the student velocities and technical the monitorial control of the student velocities and technical the monitorial control of the student velocities and technical the monitorial control of the student velocities and technical	osites, Acand Self-Self-Self-Self-Self-Self-Self-Self-	Low Streetive Vibsensing I eto: setive Vibsensing I eto: sals, smale cine and cine and indical for improducing and under advances advances 6.22/2023	ration Cor Piezoelect rt structur d engineer cesses to field. ve or revi derlying ph d self-hea	estro-magne Sensors an atrol, Active ric Transduct es, piezoelecting. select the se the designation of the d	POsetric, 1 best 1, 2 in of 1, 2, 3 EMs ns of 1, 2, 3,	s and shape on of Smart trol, Passive Harvesting S PSOs 1 1 3 2 3 2 3,4 3 4,5 3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3			√			
CO4			√			
CO5				✓		
CO6				✓		

COURSE ARTICULATION MATRIX

CO / POs	PO1	P02	PO3	P04	PO5	P06	PO7	P08	P09	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3												2		
CO2	3	2			/								2		
CO3	3	2	1										1	2	
CO4	3	2	1	/	/								1	2	
CO5	3	3	1	1 (1	2	2
CO6	3	2	1	1	1								1	2	2
Average	3	2.2	1	1	1					/			1.3	2	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Overview of Smart Materials: Introduction to Smart Materials - Smart structures - classification of smart structures, common smart materials. Piezoelectric materials, piezoelectric effect, Piezoceramics, Piezopolymers, Shape memory alloys (SMAs) - Shape memory effect - Shape memory polymers, Introduction to Electro-active Materials, Electro-active Polymers, Ionic Polymer - Electro-rheological Fluids - Magneto Rhelological Fluids.

Unit-2

Smart Actuators: Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications, Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magneto-volume Effect, Magnetostrictive Mini Actuators, IPMC and Polymeric Actuators, Shape Memory Actuators, Active Vibration Control, Active Shape Control, Passive Vibration Control, Hybrid Vibration Control.

Unit-3

Smart composites: Review of Composite Materials, Micro and Macro-mechanics, Laminated Composites based on the Classical Laminated Plate Theory, Effect of Shear Deformation, Dynamics of Smart Composite Beam, governing Equation of Motion. Advances in smart structures; Self-Sensing Piezoelectric Transducers, Energy Harvesting Materials.

Unit-4

Applications: Elastic memory composites, Smart corrosion protection coatings, Self-healing materials, MEMS - MEMS Product development - Deployment devices - Molecular machines.

Sensing Applications; Piezeoelctric Strain Sensors, Accelerometers, Effect of Electrode Pattern, Active Fibre Sensing, Application of Smart Sensors for Structural Health Monitoring (SHM).

TEXT BOOKS

1. Mohsini Shahenpoor (Ed.), "Fundamentals of Smart Materials", RSC, Cambridge, UK, 2020

							111111111111111	
2. Chander Prakash,	Sunnreet Singh	L Paulo Dav	/im (Ed.) F	unction	al and Sm	art Materials	CRC Pres	s 1 st Edition
2021.	Sumpreet Singh,	J. I aulo Dav	/IIII (Lu.), I	unction	ar aria Siri	art iviaterials	, CICTTES	s, i Luition,
3. Chang Liu, "Found	dation of MEMS'	', Pearson E	ducation,	2 nd editio	on, 2012.			
4. M.V.Gandhi and I	B.S.Thompson, "S	Smart Mate	rials and S	tructure	s", Chapm	en & Hall, Lo	ondon, 199	92.
5. Mel M. Schwartz,								
6. Donald J. Leo, "Er	ngineering analys	sis of smart i	material sy	/stems",	John Wile	ey & Sons, 1 ^s	^t Edition, 2	2007.
1. Radhashyam Rai,	"Smart Material	s for Smart I	Living" No	wa Puhli	shers IIS	Δ 2017		
2. Qun Wang (Ed.),						٦, ٢٥١٦.		
3. Johannes Michae						s", Springer,	2020.	
4. Anca Filimon (Ed. CRC Press, 2019.), "Smart Materi	als": Integra	ted Desigr	, Engine	ering App	roaches and	Potential	Applications,
5. Vijay K. Varadan, & Sons, 2006.	"Smart material	systems an	d MEMS:	design a	nd develo	pment meth	odologies'	", John Wiley
6. Seung- Bok Choi	& Young-Min H	an, "Piezoel	ectric acti	uators: c	ontrol ap	plications of	smart ma	terials", CRC
Press - 2010.		. ^		/. ^		_		
7. Kwang J. Kim & S.	Tadokoro, "Elec	troactive po	lymers for	robotic	applicati	ons: artificia	I muscles a	and sensors",
Springer, 2007 JOURNALS/MAGAZ	INFS							
1. https://www.scie		ournal/iourr	nal-of-mat	erials-sc	ence-and	-technology		
2. https://www.scie								
SWAYAM/NPTEL/N	100Cs:							
1. https://nptel.ac.i	. /							
2. https://nptel.ac.ii	n/courses/122/1	02/1221020	008/					
Course Title	Flow Ana	lysis Using A	Aneve Elué	nt^	Cour	se Type	Har	d Core
Course Title	B20FR0504	Credits	Ausys Flue		Cours	lass	V Sei	mester
		2	Contact	Work	Total N	umber of		
	ILP	Credits	Hours	Load	Cla	asses	Assess	sment in
Course	Theory	1	1	<u></u>	Per Se	emester	VVCI	
a.	D 1.	1						
Structure	Practice	1	2 /	2	Theory	Practical	IA	SEE
Structure	Tutorial	0	0	0	Theory	Practical	IA	SEE
COURSE OVERVIEW	Tutorial Total	0 2	2 0 3	2 0 3	Theory 13	Practical 26	50 %	SEE 50 %
COURSE OVERVIEW This course provide applications in Medengineers in fluid floor course objective 1. To provide the knowless of the second course objective 2. To analyse the fluid 3. To provide knowless outcome 4. To analyse the Accourse outcome After the completion course outcome COURSE OUTCOME After the completion course outcome cour	Tutorial Total s practical know chanical enginee ow applications. ow and focuses of the course of the course of the course, or the course, o	ledge relatering domain Ansys-Fluer on research of the left plate and lew over the interties for value the student Course Odd dynamic full course Odd	d to Ansy It is intent uses nu culture in It basics of A through the mmersed rious geore will be ab outcomes undamental	3 s-Fluent tended to merical fluid kind to the circul bodies of the circulary of the circ	Theory 13 and demonstrates and demonst	Practical 26 constrates the the needs on algorithm of dynamics s-Fluent.	FOS 1,2,5	SEE 50 % for real-time g mechanical and analyse PSOs 1,2
COURSE OVERVIEW This course provide applications in Medengineers in fluid floor course objective 1. To provide the kn 2. To analyse the fluid 3. To provide knowl 4. To analyse the Accourse outcome After the completio CO CO1 Apply the course of the course outcome Analyse the floor course outcome Analyse the floor course outcome Analyse the floor course outcome	ractice Tutorial Total s practical know chanical enginee ow applications. ow and focuses of showledge to undertied flow over a flatedge for fluid flow erodynamic prop S (COs) n of the course, mputational fluid flow of fluid over	ledge relatering domain Ansys-Fluer on research of the left plate and lew over the identical for value of the student Course Odd dynamic fur a flat plate	2 0 3 d to Ansy n. It is intent uses nu culture in I basics of A through th mmersed rious geor will be ab outcomes indamenta , through	3 s-Fluent tended to merical Fluid kind kind kind kind kind kind kind ki	Theory 13 and demonstrates and demonstrates and demonstrates and demonstrates and demonstrates are pipe. In gadvancopipe and demonstrates and demonstrates are pipe.	Practical 26 constrates the the needs of t	POS 1,2,5 1,2,3,5,9	SEE 50 % for real-time g mechanical and analyse PSOS 1,2 1,10 1,2,3
COURSE OVERVIEW This course provide applications in Medengineers in fluid flor course of fluid flor course objective 1. To provide the known of the course objective 3. To analyse the fluid 3. To provide known of the course outcome o	Tutorial Total Total s practical know chanical enginee ow applications. ow and focuses of showledge to under the degree of fluid flow over a flat edge for fluid flow erodynamic properior (COs) In of the course, amputational fluid flow of fluid over the form of technical flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow over the fluid flow ove	ledge relatering domain Ansys-Fluer on research of the left plate and left by over the interest for value of the student Course Of dynamic fur a flat plate, all report.	d to Ansy It is intent uses nu culture in I basics of A through the mmersed rious geor will be ab outcomes Indamenta	3 s-Fluent ended to merical fluid kind he circul bodies unetries. le to:	Theory 13 and demonstrates and demonst	Practical 26 constrates the the needs on algorithm and dynamics s-Fluent.	POS 1,2,5 1,2,3,5,9	SEE 50 % for real-time g mechanical and analyse PSOS 1,2 ,10 1,2,3
COURSE OVERVIEW This course provide applications in Medengineers in fluid floroblems of fluid floroblems o	Tutorial Total s practical know chanical enginee ow applications. ow and focuses of the second of the course,	ledge relatering domain Ansys-Fluer on research of the stand the extreme for value of the student Course Codynamic fur a flat plate al report.	d to Ansy It is intent uses nu culture in It basics of A through the mersed rious geore will be ab outcomes Indamenta through of through of the company of	3 s-Fluent ended to merical fluid kind he circul bodies of metries. le to:	Theory 13 and demonstrates and cater to analysis a sematics and emit. ar pipe. Its ing Ansylving advance of the cate of the	Practical 26 constrates the the needs on algorithm and dynamics s-Fluent.	POS 1,2,5 e 1,2,3,5,9	SEE 50 % for real-time g mechanical and analyse PSOs 1,2 1,10 1,2,3
COURSE OVERVIEW This course provide applications in Medengineers in fluid floor course objective 1. To provide the known with the course outcome to analyse the fluid 3. To provide known with the course outcome After the completion course outcome	Tutorial Total s practical know chanical enginee ow applications. ow and focuses of showledge to under the did flow over a flat edge for fluid flow erodynamic prop S (COs) n of the course, computational fluid flow of fluid over the form of technical flow of fluid over the form of technical flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow of fluid over the form of technical fluid flow over the form of technical fluid flow over the fluid flow	ledge relatering domain Ansys-Fluer on research of the left plate and left work over the left student Course Odd dynamic fur a flat plate al report.	2 0 3 d to Ansy n. It is intent uses nu culture in I basics of A through th mmersed rious geor will be ab outcomes indamenta through	3 s-Fluent tended to merical fluid kind to the circul bodies to metries. le to:	Theory 13 and demonstrates and demonst	Practical 26 constrates the the needs of algorithm and dynamics s-Fluent.	POS 1,2,5 1,2,3,5,9	d Core mester sment in ghtage SEE 50 % for real-time g mechanical and analyse PSOS 1,2 1,0 1,2,3

СО	Course Outcomes	POs	PSOs
CO1	Apply the computational fluid dynamic fundamentals by using advanced solvers.	1,2,5	1,2
CO2	Analyse the flow of fluid over a flat plate, through circular pipe and document the	1,2,3,5,9,10	1,2,3
COZ	results in the form of technical report.		

CO2	Analyze the flow measuring devices and document the results in the form of	1,2,3,5,9,10	1,2,3
CO3	technical report.		
CO4	Investigate the behavior of flow around different structured objects and document	1,2,3,5,9,10	1,2,3
C04	the results in the form of technical report.		
CO5	Validate the Aerodynamic properties for flow over cylinder and document the	1,2,3,5,9,10	1,2,3
COS	results in the form of technical report.		
CO6	Estimate the Aerodynamic properties for flow over Symmetrical Aero foil and	1,2,3,5,9,10	1,2,3
000	document the results in the form of technical report.		

	Bloom's Level												
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)							
CO1		✓											
CO2				✓									
CO3		,		\wedge \checkmark									
CO4				V									
CO5			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	\wedge									
CO6				V									

CO/ POs	PO1	P02	P03	P04	PO5	90d	P07	804	P09	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	<u>/2</u>	\wedge		1		\rangle /		1	1			2	1	
CO2	3/	3 /	1	~//	1/				1	1			2	1	1
CO3	3	3	1	/	1				1	1	^		/2	1	1
CO4	3	3	1		1		// <		1	1			2	1	1
CO5	3	3	1		1			,	1	1			2	1	1
CO6	3	3	1	/	1				1	1			2	1	1
Average	3	2.83	1		1/		5		1	1			2	1	1

CO4 Investigate the results in the document the results in the res	he behavior the form of Aerodynar e form of te e Aerodyna ne results in	r of flow of techn mic pro chnical imic pro	v aroun nical rep operties report	d diffe port.	erent st	ructu er cy	red obje	ects and	d docu	ment 1,	2,3,5,	9,10	1,2,3		
CO5 Validate the results in the document th	Aerodynar e form of te e Aerodyna ne results in	mic pro	perties report	et the flow measuring devices and document the results in the form of 1,2,3,5,9,10											
results in the document the doc	e form of te e Aerodyna ne results in	chnical imic pro	report			· · · ,		1110 00	cumen	t thel1.	2.3.5.9	9.10	1.2.3		
CO6 Estimate the document the	e Aerodyna ne results in	mic pro		•						, (1.15)	_,0,0,	,	_,_,		
document th	ne results in		opertie	s for	flow o	ver S	ymmeti	rical Ae	ero foil	and 1,	2,3,5,	9,10	1,2,3		
BLOOM'S LEVELOF		the for	rm of te	echnic	al repo	rt.									
SECON SELVELOR	THECOLIRS	E OLITO	OMES												
	THECOURS	20010	COIVIES		Ble	oom's	s Level								
CO Ren	nember	Under	rstand		Apply		Ana	lyze	Ev	/aluate		Crea	te		
	(L1)	(L	.2)		(L3)		(L	4)		(L5)		(L6)		
CO1			/												
CO2				<		\rightarrow	V	/							
CO3						/	<u> </u>	/							
CO4			/_					/							
CO5					<u> </u>		<u> </u>	$\overline{}$							
CO6								/	>						
COURSE ARTICULAT	TIONMATR	IX \					<u> </u>					T	1		
CO/ POs 5	P02 P03	P04	P05	90d	P07	P08	P09	PO10	PO11	PO12	PSO1	PS02	PSO3		
CO1 3	2		1				1	1	\wedge		2	1			
CO2 3	3 1		1/				1	1			2	1	1		
CO3 3	3 1		1	\leftarrow			1	1/				1	1		
CO4 3	3 1		1		\ <u>'</u>		1	1	Ť		2	1	1		
COS 3	3 1		1				1	1			2	1	1		
Average 3	2.83 1		1				1	1			2	1	1		
Note: 1-Low, 2-Med	dium, 3-Hig	h					\rightarrow		·			1	1		
Theory															
Basics of Computat	ional Fluid	Dynam	ics		/		/								
Fluid properties, Typ	pes of Fluid	flow, In	ntroduc	tion to	CFD, (Capab	ilities o	t CFD, E	Discussi	on on (overr	ning Equ	uation		
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Practice															
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No	(FI	<i></i>	1 .					Tecl	hnique	s	//	Ability			
1 Analysis o	t Flow over	a flat p	olate					Ansy	's-Fluer	nt	Ha	nds on	<u>.</u>		
	of Flow thro	ugh cira	cular ni	ne				Ansv	rs-Fluer	nt	EXP EXP	nds on			
Analysis o	. I IOVV LIII U	abii cii (caiai pi	۲۰				Allsy	5 i idel		Ехр	erience	9		
2 Analysis o			lysis of Flow Measuring devices (Venturi meter and								Experience Llands on				
2 Analysis o	of Flow Mea	suring	devices	(Vent	uri me	ter ar	ıd	Ansy	s-Fluer	nt	На	nds on			
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2 Analysis o 3 Analysis o orifice me	of Flow Mea eter) n of minor l	osses ir	devices	(Vent	curi me	ter ar	r pipe	Ansy Ansy	rs-Fluer rs-Fluer	nt nt	Ha Exp Ha	nds on erience nds on	9		

_	Analysis of Notches	Ansys-Fluent	Hands on
3			Experience
-	Flow over a cylinder	Ansys-Fluent	Hands on
6			Experience
7	Flow over a symmetrical Aero foil	Ansys-Fluent	Hands on
/			Experience

TEXT BOOKS

1. Suhas V Patankar, "Numerical Heat Transfer and Fluid Flow", CRC Press, 1st Edition, 2018.

REFERENCE BOOKS

- 1. Norman Rhodes, "Computational Fluid Dynamics in Practice", Wiley, 1st Edition, 2001.
- 2. Jhon D Anderson, "Fundamental of Computational fluid dynamics", McGraw-Hill Publications, 6th Edition, 1995

JOURNALS/MAGAZINES

- 1. International Journal of Computational Fluid Dynamics, Taylor and Francis.
- 2. Progress in Computational Fluid Dynamics, An International Journal, Inderscience Publishers.

SWAYAM/NPTEL/MOOCs:

- 1. Computational Fluid Dynamics, by Prof. Suman Chakraborty, IIT Kharagpur (https://onlinecourses.nptel.ac.in/noc21_me126/preview)
- 2. Foundation of Computational Fluid Dynamics, by Prof. Vengadesan, IIT Madras (https://onlinecourses.nptel.ac.in/noc20_me64/preview)

Course Title	Flu	uid Machines	Lab		Cour	se Type	Hard	d Core	
Course Code	B20ER0505	Credits		1	C	lass	V Semester		
	TLP	Credits	Contact Hours	Work Load	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	umber of asses	Assessment in Weightage		
Course	Theory	\(\hat{0} \)	0 /	0	Per Se	emester			
Structure	Practice	1	<u></u>	2	Theory Practical		IA	SEE	
	Tutorial	0	0	0	Theory	Fractical	IA.	JEL	
	Total	1	2	2	0	26	50 %	50 %	

COURSE OVERVIEW

Fluid Machines Lab is focused on the applications of theoretical concept learned from the Fluid mechanics and machines course. The students will be conducting experiments in the laboratory pertaining to determination of losses of fluid flow through pipe, calibration of flow measuring devices, performance testing of Hydraulic turbines, Centrifugal Pumps, blowers and Reciprocating pumps.

COURSE OBJECTIVES

- 1. The course will impart practical knowledge in verification of principles of fluid flow.
- 2. To introduce various fluid flow measuring devices and determine discharge.
- 3. To introduce the experimental procedure in conducting the performance testing of various fluid machineries.
- 4. To understand the performance characteristics of various fluid machineries.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes	POs	PSOs
CO1	Describe the properties of fluids.	1	1
CO2	Determine the energy losses for fluid flow through pipe and its fittings and document the results in the form of technical report.	1,2,3,9,10	1,2,3
	Determine the discharge for fluid flow through pipes and open channel and document the results in the form of technical report	1,2,3,9,10	1,2,3

1 (()4	Compute the coefficient of impact for jet striking the vanes and document the results in the form of technical report.	1,2,3,9,10	1,2,3
CO5	Conduct experiments, interpret the data, analyze the Centrifugal and reciprocating power absorbing machines and document the results in the form of technical report.		1,2,3
CO6	Conduct experiments, interpret the data, analyze the hydraulic power generating machines and document the results in the form of technical report.	1,2,3,9,10	1,2,3

CO4 Comp	ute 1	the co	efficie	nt of in	npact f	or jet	strikin	g the	vanes a	and do	cumen	t the	1,2,3,9,	10	1,2,3
Cond CO5 powe	uct ex	ne fori xperim sorbing	m of te ents, i g mach	nterpre nines a	t the dand	ata, ar umen	alyze t	he Cer esults	ntrifuga in the	l and re	eciproc	ating nnical	1,2,3,9,	10	1,2,3
repor	t.					la 4 a a		4h a h.	مانان مسام						
CO6 mach	ines a	and do	cumer	nt the re	esults i	n the f	orm of	techn	ical rep	ort.	gener	ating	1,2,3,9,	10	1,2,3
BLOOM'S LE	VELC	F THE	COURS	SE OUT	COMES										
со	R	emem	ber	Unde	rstand		IB vlaaA	oom's	Level Ana	lvze	E	valuate	2	Crea	ate
		(L1)		(L	.2)		(L3)		(L	4)		(L5)		(Le	6)
CO1				•	/										
CO2	1					1	1								
CO3							✓	\rightarrow							
CO5	+									/					
CO6							> /	/							
COLIRSE ART	וכווו	ΔΤΙΩΝ	IMATR	elx									l		
CO/ POs		2	<u>8</u>	4	72	9	<u>,</u>	<u> </u>	6	10	Z	12	01	02	03
, CO1	2	8	\ <u>S</u>	9	8	<u>8</u>	8	8	8	2	\ <u>S</u>	8	- PS	PS	PS
CO2	3 /	2	1						3	2			3	2	1
CO3	3	2	1			/			3	2			3	2	1
CO4	3	2	1						3	2<			3	2	1
CO5	3	3	1						3	3			3	2	1
CO6	3	3	1						3	3			3	2	1
Note: 1-Low	3-M	2.4 ledium	3-Hig	rh -				/	3	2.2			2.8	2	1
CO4 Compresult Condition CO5 CO6 CO1 CO2 CO3 CO4 CO5 CO6 CO6 CO1 CO2 CO3 CO4 CO5 CO6 CO6 CO9	ation ation n of V ation	of frict of min /eturin of forc	cion factor for loss neter, see deve	ctor and ses for f Orifice (eloped l	d Reyno fluid flo meter, by impa	old's n withro flow n act of	Part- umber ough pi ozzle a jets on Part-	for the pe fitted of th	e fluid f ings. ootch.	lowing	throu	gh pipe	25.		
1. Performar	nce te	est on S	Single	stage C	entrifu	gal pu	mp to o	draw N	/lain an	d Oper	ating c	haract	eristic c	urves	
Performar	nce te	est on I	viuiti- Recipro	stage C ocating	pump	gai pu to dra	mp το (w Mair	araw N n and (nam an Operatir	u Oper ng char	acteris	iiai act stic cur	ves.	.ui ves	
4. Performar	nce te	est on t	two sta	age Rec	iprocat	ing ai	compi	ressor		J :			•		
5. Performar	nce te	est on (Centrif	ugal air	blowe	r.									
6. Performar	nce te	est on I	Pelton	turbine	to dra	w Ma	in and (Opera	ting cha	racteri	stic cu	rves.			
7. Performai 8. Performai	nce te	est on l	-rancis Kaplan	turbin	e to dra e to dra	aw Ma aw Ma	in and	opera Opera	ting cha	aracter aracteri	istic cu istic cu	rves.			
TEXT BOOKS 1. Dr. Bansal	i ,"Flu al"⊑	iid Med	chanic	s and M	lachine Hydrai	ry", R.	K.Laksh	nmi Pu	blicatio	ons, 201	18.	dition (2012		
L. Jugudisii L	, I	.a.a IVI	Conan	ics und	,	, 1	.ca opt	JIICUII I		zinpan)	,, -	G1011 1	-014.		

CO/ POs	PO1	P02	БО	P04	PO5	90а	P07	80d	60d	PO10	PO11	P012	PS01	PSO2	PSO3
CO1	3		\wedge				\rangle /			1			2		
CO2	3/	2 /	1	///					3	2			3	2	1
CO3	3	2	1	/					3	2/	^		<u>/</u> 3	2	1
CO4	3	2	1						3	/ 2<			3	2	1
CO5	3	3	1						3	3			3	2	1
CO6	3	3	1	,					3	3			3	2	1
Average	3	2.4	1						3	2.2			2.8	2	1

REFERENCE BOOKS

1. Yunus A. Cengel and John M.Cimbala, "Fluid Mechanics (SI Units)", 4th edition, Tata McGraw Hill, 2019.

2. Pijush.K.Kundu, "Fluid Mechanics", Taylor & Francis, 3rd edition, 2015.

JOURNALS/MAGAZINES:

1. https://www.cambridge.org/core/journals/journal-of-fluid-mechanics

SWAYAM/NPTEL/MOOCs:

- 1. https://onlinecourses.nptel.ac.in/noc22 me31/preview
- 2. https://www.my-mooc.com/en/categorie/mechanical-engineering

Course Title	H	leat Engine I	Lab		Cours	se Type	Hard Core			
Course Code	B20ER0506	Credits	1	l	С	lass	V Semester			
	TLP	Credits	Contact	Work	Total N	umber of	Assessment in Weightage			
	ILP	Credits	Hours	Load	Cla	isses				
Course	Theory	0	0	0	Per Se	emester				
Structure	Practice	1	2/	2	Theory	Practical	IA	SEE		
	Tutorial	0	0	0 0		Practical	IA	SEE		
	Total	1	2	Z	0	26	50 %	50 %		

COURSE OVERVIEW

This course deals with the conduction of experiments to find the various properties of fuel such as Flash point, Fire point, Calorific value, Viscosity and these properties are essential to find the substitute fuel for IC engine. This course also deals with evaluation of performance parameters of IC Engines and enable the students to have hands on experience to conduct performance test on IC engines. Also describes the method of determining the area of regular and irregular geometry by using planimeter. The practical work enables the students to gain expertise and become familiar automobile sector.

COURSE OBJECTIVES

1. This course will provide a basic understanding of fuel properties and its measurements using various types of measuring devices

- 2. To determine area of regular and irregular geometrical figures
- 3. Energy conversion principles, analysis and understanding of I C Engines will be discussed. Application of these concepts for these machines will be demonstrated.
- 4. Performance analysis will be carried out using characteristic curves
- 5. To give students hands on practice to evaluate performance of petrol and diesel engines.
- 6. To know the various heat losses by drawing heat balance sheet.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes	POs	PSOs	
CO1	Evaluate the flash and fire point of the given petroleum products by using suitable	1,2,9	1	
001	apparatus and suggest the suitable lubricant for stated engine conditions.	1,2,3	1	
CO2	Calculate the area of regular and irregular geometrical surfaces.	1,9	1	
CO3	Compare calorific value of the fuels and estimate the amount of energy content.	1,2,9	1,2	
CO4	Draw and interpret the valve timing diagram of four stroke engine.	1,9	1,2,3	
CO5	Evaluate the frictional power in a multi cylinder engine by Morse test.	1,2,9	1,2,3	
	Conduct experiments, interpret and analyze the result of IC engine performance	1,2,4, 9,10	1,2,3	
	and document the results in the form of technical report.	1,2,4, 9,10	1,2,3	

BLOOM'S L	BLOOM'S LEVELOF THECOURSE OUTCOMES Bloom's Level														
со	CO Remember Understand Apply Analyze Evaluate Create														
	(L1) (L2) (L3) (L4) (L5) (L6)														
CO1	11 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \														
CO2	CO2 \(\)														
CO3	3														
CO4	CO4														
CO5									✓	/					
CO6												✓			
COURSE AF	COURSE ARTICULATIONMATRIX														
CO/ POs	01	00	03	40	905	90	70	80	60	010	011	012	501	505	503
CO1	2	1				-			1				1		
CO2	2				,	\wedge			1				2	1	
CO3	3	2				_			1				2	1	
CO4	3	1		/	/				3				2	1	1
CO5	3	2		1					3	3			2	2	1
Average	2.6	2		1					2	3			1.8	1.2	1
 Determing Determing Clevelang 	nation nation ıd's (O	of Calc of Fla pen Cu	orific va ish poi p) App	alue of nt and aratus.	gaseou Fire p	is fuels oint o	i. f lubric	cating	oil usir	ng Abe	l Pensl	ky and	Marte	en's (clo	osed) /
Performand efficiency, S a. For b. For	ce Test SFC, FF ur stro ur stro	ts on I.(P, A:F R ke dies ke peti	C. Engir latio he sel Engi rol Eng	nes, Cal eat bala ne ine	culatic ince sh	ons of II eet for	Part- P, BP, T the er	B herma ngines.	l efficie	encies,	Volum	etric ef	ficienc	y, Mec	hanical
d. Tw e. Va	o stro	ke petr	ol engi	ine ratio L0	î. Fngir	ne.									
					J.,										
1. P.K. Nag REFERENCE	"Engir E BOO I	neering KS	Therm	nodyna	mics" 1	Гata М	cGraw	Hill, 6t	h Editio	on 201	8.				
1. R.B.Math 2. Yunus A	nur and Cene ion, 20 M Rati	d R.P.S gal an 002. hore, "	harma, d Mich Therm	Intern nael A. al Engir	al Com Boles, neering	ibustio "Theri g", Tata	n Engir modyn a McGr	nes., Di amics aw-Hil	hanpat -An En I, Prent	Rai pu gineer ice-hal	blication ing Ap	on, 200 proach lia Pvt.	2. ", Tata Ltd.	n McGr	aw-Hill
gublicat 3. Mahesh	BLOOM'S LEVELOF THECOURSE OUTCOMES CO Remember Understand Apply Analyze Evaluate Create														
3. Mahesh JOURNALS, 1. Internati 2. Americal	/MAG ional Jo n Instit NPTEL	ournal oute of	of Heat Aerona Cs	autics a	nd Ast	ronaut	ics								

CO/ POs	PO1	P02	PO3	P04	PO5	P06	POZ	P08	PO9	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	2	1							1				1		
CO2	2				/	\wedge			1				2	1	
CO3	3	2							1				2	1	
CO4	3			/	/	\wedge	//		3				2	1	1
CO5	3	3							3				2	1	1
CO6	3	2		1					3	3			2	2	1
Average	2.6	2		1					2	3	\wedge		1.8	1.2	1

Course Title	Indian [*]	Traditions a	nd Culture	Cours	е Туре		FC		
Course Code	B20PA0501	Credits	1		Cl	ass	V Semester		
	TLP	Credits	Contact	Work	Total N	umber of	Assessment in Weightage		
	ILF	Credits	Hours	Load	Cla	isses			
Course	Theory	1	1	1	Per Se	emester			
Structure	Practice	0	0	0	Theory	Practical	IA	SEE	
	Tutorial	0	0	0	Theory	Practical	IA	SEE	
	Total	1	1	1	13	0	50 %	50 %	

1. https://wwv	.courser	ra.org/b	rowse	/physica	l-scie	nce-and	d-eng	ineerin	g/mech	anical-	engine	eering		
2. https://wwv	.my-mo	oc.com/	'en/ca	tegorie/	mech	anical-	engine	eering						
Course Title	i.ac.in/co	Indi	ian Tra	aditions	and C	ulture			Cour	se Tyne	<u>, </u>		FC	
Course Code	B20	0PA050	1	Credits		1			C	lass	+	V S	Semest	er
	w.coursera.org/browse/physical-science-and-engineering/mechanical-engineering w.my-mooc.com/en/categorie/mechanical-engineering el.ac.in/cours Inflain Traditions and Culture													
Course	1	Theory		1		1		1	Per Se	emeste	r		Cigiita	
Structure	P	ractice		0		0	(Т	heory	Pract	ical	IA		SEE
	T	utorial		0		1	() •	12			E0 0/	<u> </u>	:0 º/
COLUBER OBJEC	TIVES	rotal		1		1	1 -	L	13	0		50 %	5	00 %
5. Help studen 4. Help learner COURSE OUTC After the comp	s unders s unders OMES (C letion of	tand the COs)	e india e facto irse, th	an spiritu ers which ne studer	unite	the di	verse	culture	are es of Ind	dia .				
со			_<	Course O	utco	mes			$\overline{}$		P	Os	PS	Os
CO1 Ga	n concep	otual un	dersta	nding of	India	n cultu	re an	d tradit	tions.		8,9	9,10		
CO2 De	scribe va	rious an	cient t	theories	in tre	atment	of ar	y disea	ase.		8,9	9,10		
СОЗ Ар	oreciate t	the scie	nce an	d techno	logic	al adva	ncem	ents in	ancient	India.	8,9	9,10		
CO4 Cor	nprehen ditation	d the I	ndian vana.	spiritual	aspe	ects of	India	n cultu	ire like	yoga,	8,9	9,10		
CO5 Of I	monstrat naking v	te the th arieties	eory b of foo	pehind co	elebra	ating H	indu f	estivals	s and co	ncept	8,9	9,10		
CO6 Un	derstand	I India a	s a lan	d united	by cu	ltural c	liversi	ity.		*	8,9	9,10		
BLOOM'S LEVE	L OF THI	E COURS	SE OU	TCOMES		>							_	
						Bloo	m's L	evel			_		_	_
CO F	(L1)	er U	Inders (L2)	tand	A _l	pply L3)		Analy (L4)	ze	Eval	uate .5)		Create (L6)	•
CO1	√			V	<									
CO3	<u>۷</u>			ν √										
CO3				<u>√</u>										
CO5				\ \										
CO6	√			√										
COLIRSE ARTIC	ULATION	N MATR	IX				l					1		
COOKSE AKTIC	22	33	74	25	90	70	90	60)10)11	112	01	02	03
co/ 5	2	7	ΡC	7	Z	PC	Þζ	٦	PO	PO	PO	S	PS	PS
CO / POs							2	2	2					
CO / POs CO1							2	2	2			1		1
CO / POs CO1 CO2							2	2	2			1	-	
CO / POs CO1 CO2 CO3 CO4			Ì					2	2			-		
CO / POS CO1 CO2 CO3 CO4 CO5							٠,	,						
CO / POs CO1 CO2 CO3 CO4 CO5							2	2	2					

		Bloom's Level													
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)									
CO1	√	√													
CO2	√	√													
CO3	√	√													
CO4	√	√													
CO5	√	√													
CO6	√	√													

CO / POs	PO1	P02	PO3	P04	PO5	P06	PO7	P08	P09	PO10	P011	P012	PSO1	PSO2	PSO3
CO1								2	2	2					
CO2								2	2	2					
CO3								2	2	2					
CO4								2	2	2					
CO5								2	2	2					

CO6				2	2	2			
Average				2	2	2			

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Indian Tradition

Culture: Indus Valley Civilization and early cultural practices, The Vedic culture, Influence of Buddhism and Jainism on Indian Culture, Influence of Islam and Christianity, Indian Cultural Renaissance of the 19th Century **Religion**: Pre-vedic and Vedic religion, Jainism, Buddhism, Hinduism, Religious Reform Movements, Advent of Christianity

Art: Introduction to Natyashastra, classical and contemporary art forms (dance and music), regional art forms (dance and music), Folk art, puppetry

Architecture: – Engineering and Architecture in Ancient India, Evolution of Hindu Temple Structures, Sculptures, Coins and Pottery from Ancient India v. Literature- Vedas, Upanishads, Ramayana, Mahabharata & Bhagavat Gita.

Unit-2

Contribution of ancient India to Science and Maths

Development of Science in Ancient India: Astronomy, Mathematics, Medicine, Metallurgy.

Scientists of Ancient India: Mathematics and Astronomy- Baudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya. Science- Kanad, Varahamihira, Nagarjuna. Medical Sciences (Ayurveda and Yoga) - Susruta, Charaka, Yoga and Patanjali

Science and Scientists in Medieval India: Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture.

Scientists in Modern India: Srinivas Ramanujan, Chandrasekhara V Raman, Jagadish Chandra Bose, Homi Jehangir Bhabha, Dr, Vikram Ambalal Sarabhai, Dr. APJ Abdul Kalam.

Unit-3

Indian Spiritual Aspects

Hindu Spirituality Based on Shruti and Smriti: Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana, Mahabharata and Bhagavat Gita.

Hata Yoga and Pranayama: Main Features, Basics of Yoga –Different kinds of Yoga; Raja Yoga (Ashtanga yoga); Karma yoga;

Bhakti Yoga: Yoga of Loving Devotion; Jnana yoga – Yoga of Knowledge; Hatha Yoga (Asana/ Pranayamas); Kundalini Yoga; Nada Yoga; Sannyasa Yoga

Buddhist, Jaina Spiritualities: Main Doctrines of Buddhism: Four Noble Truths (Arya Satya), Concept of Nirvana - Ashtanga Marga.

Unit-4

Unity in Diversity

Commensality and the Significance of Food: Eating Together as Family and as a Society, Food at Rituals, annaprasan, marriage and funeral, Kitchen as Shared Space for Women, Food and Nationalist Response of Indian Community, Visibility of Indian Cuisine in the World

Celebrating Diverse Festivals: Festival Types: Religious and Seasonal, Religious - Holi, Diwali, Ganesh Chaturthi, Janmashtami, Mahavir Jayanthi, Ramadan, Christmas, Buddha Purnima; Seasonal (harvest festivals) - Baisakhi, Pongal, Sankranti

Attire: Indus Valley Civilization, Vedic period, Modern India.

TEXT BOOKS

- 1. Sundararajan K.R., "Hindu Spirituality Vedas through Vedanta, Cross Road Publications", New York, 1997.
- 2. Griffiths Bede, "Yoga and the Jesus Prayer Tradition, Asian Trading Corporation", Bangalore, 1992
- 3. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998

Course Title		Heat Transf	er		Cour	se Type	Hard	d Core
Course Code	B20ER0601	Credits	3	3	С	lass	VI se	mester
	TLP	Credits	Contact	Work			Accord	sment in
	ILF	Credits	Hours	Load	Classes			ghtage
Course	Theory	2	2	2	Per Se	emester	vvei	giitage
Structure	Practice	0	0	0	Thoony	Tutorial	IA	SEE
	Tutorial	1	2	2	Theory Tutorial		IA	SEE
	Total	3	4	4	26 26		50 %	50 %

СО	Course Outcomes	POs	PSOs
CO1	Describe the three modes of heat transfer and their governing equations.	> 1	1
CO2	Analyse the combined mode of heat transfer through composite walls and fins.	1,2	1,2
L CO3	Apply Lumped system and Heisler chart analysis to interpret transient heat conduction phenomenon.	1,2,3,5	1,2
CO4	Identify and apply the appropriate method to solve heat transfer problems.	1,2	1,2
CO5	Design heat exchangers using LMTD and Effectiveness-NTU method.	1,2,3,5	1,2
CO6	Analyse the phase change convective process during boiling and condensation process.	1,2	1

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 Sen Taylor, Thapar, Roi 	collen. mila, Re	. Feasi eading	s and Fas s in Early	ts: A Histo Indian Hi	story.	Oxford	ı ındıa. Univer	reakt sity Pi	ion Bo ress. I	ooks, New Jew Delhi	Deini, . , 2018	2014.	
• ,	ŕ		•		•			•					
					c t	h Sama	ctor						
Course Ti	tle			Heat Tra	nsfer	Jeille	Stei		Cours	e Type		Hard Co	re
Course Co	ode	B20	ER0601	Credit	s	3	}		Cl	ass	,	VI semes	ter
			TLP	Credit	s C	ontact Hours	Work Load	То	tal Nu Cla	imber of sses	А	ssessmei Weighta	nt in
Course		Т	heory	2		2	2	F	er Se	mester		vveigiita	80
Structur	e	Pr -	actice	0		0	0	The	ory	Tutorial	IA		SEE
	ŀ	Tu	itorial	1		2	2	1		26	F0	0/	E0 0/
COLIBSE OVE	D\/IE\A/		отаі	3		4	4	2	ס	26	50	70	5U %
Course Ti Course Co Course Structur COURSE OVEI Heat Transfer provides the I for application COURSE OBJE 1. To introduc 2. To identify 3. To analyze 4. To design h COURSE OUT After the com CO CO1 Describ CO2 Analys CO3 Apply I phenoi	eat exc COMES pletion De the t e the co	change (COs) of the three combined system	e course, modes of ed mode	the stude Cou heat tran of heat tr	ing ar nt wil rse O sfer a ransfe rt ana	nd conc utcome nd thei r throu lysis to	e to: es r gover gh com	ning e	quation walls	ons. and fins.	duction	POs 1 1,2	PSOs 1 1,2
pheno	menon.				\							1,2,3,3	1,2
	y and a _l	pply t	ne approp	riate mè	thod t	o solve	heat tr	ransfe	r prot	ilems.		1,2	1,2
COE Docing	host s	n: 1n	gers using	S FINITE BL	IU EITE	cuven	255-IN I U	meth.	cond	ensation r	orocess	1,2,3,5	1,2
CO4 Identificos Design	heat ex	hase c	hange co	nvective i	און נאנ די	s aurin	& DOML	ig and	95.14			-,-	
CO4 Identificos Design CO6 Analys BLOOM'S LEV	heat ex e the pl 'EL OF T	hase c	hange co	JTCOMES	ioces	s durin	g bonir	ig and	,			<u> </u>	
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV	heat execution to the desired	hase c	hange co	JTCOMES	oroces	Blo	oom's L	evel					
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO	heat execute the photostal representation of the photostal rep	hase of	DURSE OU	JTCOMES erstand	oroces	Blo Apply	oom's L	evel Anal	yze	Eval	uate	Cre	eate
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO	heat execute the photograph of	hase of the Company o	DURSE OU	JTCOMES erstand (L2)	oroces	Blo Apply (L3)	oom's L	evel Anal	yze l)	Eval (L	uate 5)	Cre (I	eate L6)
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1	heat executed the plant of the	hase of THE Community embers	r Und	JTCOMES erstand (L2)	Silves	Blo Apply (L3)	oom's L	evel Anal (L4	yze I)	Eval (L	uate 5)	Cre (I	eate L6)
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1 CO2 CO3	heat execution heat e	hase of THE Co	change co	erstand (L2)	Silvices	Blo Apply (L3)	pom's L	evel Anal	yze I)	Eval (L	uate .5)	Cre (I	eate L6)
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1 CO2 CO3 CO4	heat executive the photostate of the photostate	hase of THE CO	change co	erstand (L2)	offoces	Blo Apply (L3)	pom's L	evel Anal (L4	yze I)	Eval (L	uate 5)	Cre (I	eate L6)
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1 CO2 CO3 CO4 CO5	heat execution heat e	hase of the Company o	r Und	erstand (L2)	Sinces	Blo Apply (L3)	pom's L	evel Anal (L4	yze I)	Eval (L	uate 5)	Cre (I	eate L6)
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1 CO2 CO3 CO4 CO5 CO6	heat executive the photograph of the photograph	hase of the Company o	change co	erstand (L2)	sioces;	Blo Apply (L3)	pom's L	evel Anal (L4	yze i)	Eval	uate 5)	Cre (I	eate L6)
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTI	Remo	embe	change co DURSE OU r Und	erstand (L2)	Silver	Blo Apply (L3)	pom's L	evel Anal (L4	yze I)	Eval	uate 5)	Cre (I	eate L6)
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTI CO/ POs	Remo (I	embe	r Und	erstand (L2)	904	Blo Apply (L3)	g bollir	evel Anal (L4	yze 1)	PO11	uate (5)	Cre (I	eate L6)
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTI CO/ POs CO1	Remo (I	embe	change co	erstand (L2)	900	Blo Apply (L3)	g bollir	evel Anal (L4	yze t)	PO111	D015	Cre (I	eate L6)
CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTI CO/ POs CO1 CO2	Remo (I	embe L1)	change co DURSE OU r Und ATRIX	erstand (L2)	90	Blo Apply (L3)	g bollir	evel Anal (L4	yze	PO11	uate (5)	Cre (I	eate L6)
CO1 Descrit CO2 Analys Apply I phenor CO4 Identif CO5 Design CO6 Analys BLOOM'S LEV CO CO1 CO2 CO3 CO4 CO5 CO6 COHRSE ARTI CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 CO1 CO7 CO7 CO7 CO8 CO8 CO8 CO9 CO9 CO9 CO9 CO9	Remo (I	embe L1)	change co DURSE OU T Und ATRIX 2	erstand (L2)	904	Blo Apply (L3)	g bollir	evel Anal (L4	yze 1)	PO11	uate (5)	Cre (I	eate L6)

CO/ POs	PO1	PO2	БОЗ	P04	50d	90d	PO7	80d	60d	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	3												3		
CO2	3	2											1	2	
CO3	3	3	2		1								2	1	

CO4	3	2						1	1	
CO5	3	2	2	1				1	1	
CO6	2	3						1		
Average	2.8	2.4	2	1				1.5	1.25	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Heat transfer: Modes and Basic governing laws of heat transfer, Boundary conditions, Thermal contact resistance, Overall heat transfer coefficient, 3-D heat conduction equation in Cartesian co-ordinates, Discussion on 3-D conduction equation in Cylindrical & Spherical coordinates, 1-D steady state heat conduction without heat generation (plane wall, cylinders & spheres), Thermal Resistances in Series and in Parallel, Numerical.

Conductive Heat transfer: Critical thickness of insulation on spheres and cylinders, Introduction to fins, Discussion on governing equations for different conditions of fins, effectiveness & efficiency of fin, Numerical.

Unit-2

1-D Transient Conduction: Lumped system Analysis, Use of Heisler's charts for transient conduction in plane slab, long cylinder, and sphere. Numerical examples, Introduction to Numerical analysis of Heat conduction **Natural Convection:** Hydrodynamic and thermal boundary layer over a flat plate and Flow through duct, critical Reynolds number, Application of dimensional analysis for free convection, Numerical.

Unit-3

Forced Convection: Applications of dimensional analysis for forced convection, physical significance of Reynolds, Prandtl, Stanton, Nusselt numbers, Numerical on applications involved with laminar and turbulent flow.

Radiation Heat transfer: Thermal radiation, definitions of various terms, Laws of black body radiation-Stefan Boltzmann, Wein's displacement law, Kirchhoff's law, Planck's law, Black body concept, Discussion on radiation shape factor, Discussion on heat exchange between two gray bodies (Infinite parallel planes), Discussion on effect of radiation shields, Numerical.

Unit-4

Heat Exchangers: Classification, Overall heat transfer coefficient, fouling and fouling factors, LMTD, Discussion on effectiveness-NTU method of analysis of heat exchangers, Numerical.

Phase Change Convective Process: Condensation and its types, Discussion of condensation with Nusselt theory, Reynolds number for condensate flow. Boiling-types of boiling, Regimes of pool boiling, Pool boiling correlations, Numerical.

CASE STUDIES

- 1. Develop the python programming to understand the one dimensional heat equation and draw the temperature variation.
- 2. Develop the python programming for analyzing the 2D temperature distribution.
- 3. Development of a MATLAB Program for Transient Heat Transfer Coefficient Studies.
- 4. How refractory layers are organized in furnace construction and explain the conceptual design.
- 5. Discuss the heat transfer theory behind the design of Microwave oven and Egg boiler.

TEXT BOOKS

- 1. Tirumaleshwar, "Heat & Mass Transfer", Pearson Education, 2nd Edition, 2012.
- 2. Ozisik, "Heat transfer-A basic approach", Tata McGraw Hill, 1st Edition, 1985.

REFERENCE BOOKS

- 1. Yunus A-Cengel, "Heat and Mass Transfer", Tata McGraw hill, 6th Edition, 2020.
- 2. Mahesh M Rathore, "Heat and Mass Transfer", Laxmi publications, 3rd Edition, 2016.
- 3. Frank Kreith, Raj. M. Manglik, Mark. S. Bohn, "Principles of Heat Transfer", Thomas Learning, 7th Edition, 2010.
- 4. Frenk P.Incropera and DavidP.Dewitt, "Principles of Heat and Mass transfer", John Wiley and sons, 6th Edition, 2018.
- 5. R K Rajput, "A Textbook of Heat and Mass Transfer", S Chand Publications, 7th Edition, 2019.

JOURNALS/MAGAZINES

Course Title	Finite	e Element M	ethods		Cours	е Туре	Har	d core
Course Code	B20ER0602	Credits	;	3	С	lass	VI Se	mester
	TLP	Credits	Contact	Work	Total N	umber of	Accos	sment in
	ILF	Credits	Hours	Load	Cla	asses Weight		
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Structure	Practice	0	0	0	Theory	Tutorial	IA	SEE
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The Journal of He International Journal	eat Transfer, ASN rnal of Heat and	ЛЕ. Mass Trans	fer, Elsevie	er.					
SWAYAM/NPTEL/N 1. Heat	NOOCs: Transfer,	By P	rof.	Ganesh	Visv	vanathan,	IIT	Во	mbay,
2. Heat https://onlinecourse	es.nptel.ac.in/no Transfer, es.nptel.ac.in/no	oc2u_cn12/p By P oc19_ch23/p	preview rof. preview	Sunand	o Da	sgupta,	IIT	Khar	agpur,
Course Title	Finit	e Element N	Methods		Cours	e Type	 	lard core	
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			Bloom	's Level		
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CO1		✓				
CO2			✓			

CO3			✓	
CO4		✓		
CO5		✓		
CO6		✓		

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	P04	PO5	90d	P07	P08	P09	PO10	P011	P012	PS01	PSO2	PSO3
CO1	3	3											3	2	
CO2	3	1											3	3	
CO3	3	3	2		3							1	3	2	1
CO4	3	3	2										3	3	1
CO5	3	3	2										3	2	1
CO6	3	3	3		3							1	3	3	1
Average	3	2.66	2.2		3	<	1					1	3	2.5	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Introduction to FEM, Steps involved in FEM, Phases of FEM, Engineering applications, Advantages, Disadvantages, List of commercial FEM Packages.

Discretization: Types of elements used in FEM, Shape and behavior, Choice of element types, size and number of elements, Location of nodes, Node and Element numbering, coordinate systems, and Convergence criteria. Stiffness matrix and its properties.

لا -Unit

Interpolation polynomials: 1D Linear, quadratic and cubic. Simplex, complex, and multiplex elements. 2D PASCAL's triangle CST elements, 1D linear shape functions in NCS, and Jacobian for triangular element, numerical.

Solution of 1-D Bars: Derivation of element stiffness matrix, Numerical on bars on the uniform, stepped, and tapered cross-sections to analyze displacements, reactions and stresses by using penalty and elimination approaches.

Unit-3

Introduction: Types of trusses, Derivation of stiffness matrix, Numerical with 2 and 3 elements.

Higher Order Elements: Lagrange's interpolation, shape functions for higher order 1D elements - Quadratic and cubic element, iso-parametric, sub-parametric and super parametric elements, Shape function for linear quadrilateral element, numerical

Unit-4

Beams: Hermite shape functions for beam element, Derivation of stiffness matrix using Hermite shape functions, Numerical on beams carrying concentrated & UDL.

Heat transfer: Steady-state heat transfer, 1D heat conduction governing equation, Boundary condition, Numerical on heat conduction and convection in composite walls, and pin fins.

CASE STUDIES

- 1. Parametric Finite Element Analysis of Bicycle Frame Geometries
- 2. Truss bridge structure frame section analysis by using Finite element analysis
- 3. Stress Analysis of the truck chassis using Finite Element Analysis (FEA)
- 4. Structural dynamic analysis of storage frames.

TEXT BOOKS

1. S. S. Bhavikatti, "Finite Element Analysis", New Age International publishers, 3rd Edition, 2015.

2. Tirupathi. R. Chandrapatla, Ashok. D. Belegundu, "Finite Elements in Engineering", Pearson Education India, 4th Edition, 2015.

REFERENCE BOOKS

- 1. J. N. Reddy, "Introduction to Finite Element Method", McGraw Hill, 4th Edition, 2020.
- 2. David Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Education, 2017.
- 3. Robert D. Cook, "Concepts and Applications of Finite Element Analysis", Wiley 4th Edition, 2009

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/journal/finite-elements-in-analysis-and-design
- 2. https://www.hindawi.com/journals/mpe/si/632341/

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/112104116
- 2. https://onlinecourses.nptel.ac.in/noc20_me91/preview

Course Title	Design of	f Transmissio	n Elemei	nts	Cour	se Type	Hard	d Core
Course Code	B20ER0603	Credits		3	С	lass	VI se	mester
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes			sment in
Course	Theory	/3	3	/ 3	Per Se	emester	vvei	ghtage
Structure	Practice	0	/0/	0	Thoony	Practical	IA	SEE
	Tutorial	0	/0	O	Theory Practical		IA IA	JEE
	Total	3	3 🔨	3	39 0		50 %	50 %

COURSE OVERVIEW

Design of transmission elements deals with the basics of design concepts Involved in curved beams, springs, clutches and brakes. It provides the students with fundamental skills of engineering, and the ability to apply the theories of science to practice. This course would help to fill the gap the knowledge at graduation and step into producing the detailed design of gears & bearings in Industries.

COURSE OBJECTIVES

- 1. To enable students to design important machine elements such as springs, brakes, curved beams, flexible power transmission elements such as belts and ropes.
- 2. To enable students to design different gears such as spur gear, helical gear and bevel gear.
- 3. To help students in understanding and selection of ball and roller bearings from the standard design catalogue.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes	POs	PSOs
CO1	Solve for stresses in curved beams and design of springs.	1,2,3,6,8	1,2
CO2	Design belt and rope drives used in mechanical power transmission.	1,2,3,6,8	1,2
CO3	Design clutches and brakes for automotive applications.	1,2,3,6,8	1,2
CO4	Design spur and helical gears subjected to static, dynamic & wear load conditions.	1,2,3,6,8	1,2
L CO5	Design bevel gear for different load conditions and recommend appropriate solution.	1,2,3,6,8	1,2
CO6	Design ball and roller bearings subjected to cyclic loads and speeds.	1,2,3,6,8	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

			Bloom	's Level									
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)							
CO1			√										
CO2					✓								

CO3		✓		
CO4			✓	
CO5			✓	
CO6	✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	P02	PO3	PO4	PO5	90d	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	2	3	1			1		1					3	3	
CO2	2	2	3			1		1					3	3	
CO3	3	3	3			1		1					3	3	
CO4	2	3	3			1		1					3	2	
CO5	2	2	3			1		1					2	3	
CO6	2	3	1			1		1					3	3	
Average	2.16	2.66	2.33			1		1					2.83	2.83	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Design of Belts and Ropes: Introduction to transmission systems, Selection and design of Flat & V-belts for different applications. Rope drives: selection of wire ropes.

Curved Beams: Stresses in curved beams of standard cross sections used in crane hook, punching presses & clamps.

Unit-2

Clutches and Brakes: Design of single plate and multi plate clutch, Design of Block / Shoe brakes (Single Shoe Brake only), Band brakes - Simple Band brakes, Self-locking of brakes, Heat generation in Brakes.

Design of Springs: Types of springs - stresses in helical springs of circular section. Leaf Springs: Stresses in leaf springs and problems.

Unit-3

Design of Spur Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, Design for strength, Dynamic load and wear load.

Design of Helical Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads.

Unit-4

Design of Bevel Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads.

Ball and Roller Bearings: Bearing Life, equivalent bearing load, selection of bearings, Bearings for cyclic loads and speeds.

CASE STUDIES

- 1. Design a spring to withstand the weight of an elevator which varies from 800N to 1200N force and operating 8 Hrs /day.
- 2. Design a crane hook to lift the load of 8000N from a mine of depth 800m.
- 3. Design a clutch for a 150 cc bike by considering all the factors into consideration.
- 4. Design a gear of sugarcane crusher by considering all the factors into consideration.
- 5. Design a bearing for front suspension of a 350 cc bike.

DESIGN DATA HAND BOOKS

- 1. Lingaiah K, "Machine Design Databook", McGraw Hill Education, 2nd Edition, Vol1 & 2, 2017
- 2. Balaveera K Reddy and K Mahadevan, "Design Data Hand Book for Mechanical Engineers", CBS Publisher, 4th Edition, Kindle Edition, 2018.

TEXT BOOKS

 Richard G Budyr 		AD 1 "	.			5		ener :						
11 th Edition 202	nas and J Keith 20.	Nisbett, " S	sniegly's Med	cnanical E	ngineerin	g Design",	McGraw F	IIII Education						
2. V. B. Bhandari, "	-o. Design of Macl	nine Elemen	ts" Tata McG	iraw Hill I	Publishing	Company L	td., 3 rd Edit	tion 2017.						
REFERENCE BOOKS	5													
1. Robert L. Norton	, "Machine De Shoun I E H	sign- An Inte Iornberger	egrated Appr S. R. Sl Contri	oach", Pe ibutions I	earson Edu hv A P Hars	ication, 5 th l	Edition, 20:	18. na Flamants'						
Pearson Education	on, 8th Edition	, 2019.	3. II, 31 COIIII	ibutions i	oy AT Tidis	ona, Design	i or iviaciiii	ic Elements						
1. Richard G Budynas and J Keith Nisbett, "Shiegly's Mechanical Engineering Design", McGraw Hill Education, 11th Edition, 2020. 2. V. B. Bhandari, "Design of Machine Elements" Tata McGraw Hill Publishing Company Ltd., 3rd Edition 2017. REFERENCE BOOKS 1. Robert L. Norton, "Machine Design- An Integrated Approach", Pearson Education, 5th Edition, 2018. 2. M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. SI Contributions by A P Harsha, "Design of Machine Elements", Pearson Education, 8th Edition, 2019. 3. C S Sharma and Kamlesh Purohit, "Design of Machine Design Elements", PHI, 10th Printing, 2015. JOURNALS/MAGAZINES 1. Clutches and Brakes: Design and Selection - 2nd Edition - William C. (routledge.com) 2. http://www.ijerd.com/paper/vol12-issue1/Version-1/G12015667.pdf SWAYAM/MPTEL: Design of Machine Elements I (Mechanical Engineering) (digimat.in) 2. Gear and Gear Unit Design: Theory and Practice - Course (nptel.ac.in) Course Title Product Design by Additive Manufacturing Course Type Soft Core Course Code B20EOS611 Credits 3 Class VI Semester LTP Credits Contact Work Total Number of Classes Per Semester Course Title Product Design by Additive Manufacturing Course Type Semester Course Title Product Design by Additive Manufacturing Course Type Semester Course Title Product Design by Additive Manufacturing Course Type Semester Course Title Product Design by Additive Manufacturing Course Type Semester Course Title Product Design by Additive Manufacturing Course Type Semester Course Title Product Design by Additive Manufacturing Semester Semester Weightage Course Title Product Design by Additive Manufacturing Semester Semester Weightage Course Structure Practical O O O Theory Practical IA SEE Tutorial O O O O Theory Practical IA SEE Additive Manufacturing (AM) which is commonly known as 3D printing is a process of joining materials to make objects from 3D model data by building the model layer on layer, as opposed to subtractive manufacturing														
JOURNALS/MAGAZ	ZINES Jest Design an	d Salaction .	- 2nd Edition	- William	C (routle	dae com)								
2. http://www.ijerd	d.com/paper/v	ol12-issue1/	Version-1/G	- williaii 1201566	7.pdf	uge.com/								
SWAYAM/NPTEL/I	MOOCs:				•									
1. NPTEL: Design of	Machine Elem	nents I (Mec	hanical Engin	eering) (digimat.in))								
z. Gear and Gear O	Till Design. The	eory and Pra	ctice - coursi	e (iiptei.a	ic.iii)									
Course Title	Product Des	sign by Addi	itive Manufa	cturing	Cours	е Туре	Soft	Core						
Course Code	B20EOS611	Credits	3		Cla	ass	VI Sei	mester						
	LTP	Credits	Contact	Work	Total Nu	umber of	٨٥٥٥٥٥	ment in						
		Zi cuito	Hours	Load	Class	es Per	Assess Wei	ghtage						
Course	Lecture	3	3	3	Sem	ester		Weightage						
Structure	Practical	0	0	0 Theory Practical	IA	IA SEE								
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COURSE OVERVIEV Additive Manufactu objects from 3D m	Total V uring (AM) whinded data by I	3 ch is commo	3 only known a model layer	3 s 3D print on layer	39 ting is a pr	ocess of joi	50% ning mater	50 % ials to make						
COURSE OVERVIEW Additive Manufacture objects from 3D methodologies, such a three-dimensional significantly evolve manufacturing protechnologies. Using convention all manufacturing and course objective Additive Manufacture for producing highly of AM, various AM their applications in post-processing COURSE OUTCOMETON On successful company courses of the course of th	Total V uring (AM) which and computer Aid and over the last cesses, e.g., by a AM, manufacturing technologies, so a various fields ES (COs) pletion of this computer Aid to the last cesses and the last cesses are also as a cesses and the last cesses are various fields ES (COs)	ch is common building the lamachining ded Design (set decade be yenabling "cturing of himologies. In economicate. The main selection of the course course; the seconds of the course; the second of the course; the seconds of the course; the second of the course of the course; the seconds of the course of the cours	ally viable altropes will also cover the control of	s 3D print on layer inciple of them, can be remative this could AM, basinger AM pube able to the sould be able to	ting is a property, as opporty, as opporty	occess of joi sed to subt a model, in the directly. The seconomical seconomical seconomical strong for Addition including	ning mater tractive manitially general AM technology of the areast attract y viable all dents with the Manufal building still possible.	50 % rials to make anufacturing erated using ologies have be nature of ed by these ternative to rechnologies the concept acturing, and rategies and						
Additive Manufacture objects from 3D methodologies, such a three-dimensional significantly evolved manufacturing protechnologies. Using convention all manufacturing and convention all manufacturing protechnologies. Using convention all manufacturing protechnologies. Using convention all manufacturing of AM, various AM their applications in post-processing course outcome course o	Total V uring (AM) which odel data by the chast raditional all Computer Aided over the last cesses, e.g., by a AM, manufacturing technologies, so a various fields ES (COs) pletion of this computer all the change of the cha	ch is common building the lamachining ded Design (set decade be yenabling "cturing of himologies. In economicate. The main selection of the course course; the set th	ally viable alto objective of materials for ewill also covered to the course of the co	s 3D print on layer inciple of them, can be remative this cou AM, basinger AM processing the solution of the s	ting is a property, as opposed family as opposed family and the fabrication several and be an extra to convention to convention and be an extra to convention family as on the family and the family as on the fam	ocess of joi sed to subt ta model, in sed directly. Sensively traindustries a seconomically the for Addition including	ning mater ractive manitially general AM technology of the attract y viable all reflects with the Manufal building steps.	ials to make anufacturing erated using ologies have an ature of ed by these ternative to echnologies the concept octuring, and rategies and						
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COURSE OVERVIEW Additive Manufacture objects from 3D methodologies, such a three-dimensional significantly evolved manufacturing protechnologies. Using convention all manufacturing and the convention all manufacturing protechnologies. Using convention all manufacturing protechnologies. Using convention all manufacturing producing highly of AM, various AM their applications in post-processing COURSE OUTCOMICON Successful comparameters and lidentify, country of the parameters of of the	Total V uring (AM) which and dead data by Bech as traditional all Computer Aided over the lass cesses, e.g., by a AM, manufacturing technologies, so a various fields between the component.	ch is common building the lamachining ded Design (st decade be yenabling "cturing of himologies. In economicate. The main selection of its. The course course; the selection of its. The course course; the selection of its. The course course; the selection of its course; the se	annly known a model layer. The basic processes an model layer and the basic processes an model layer.	s 3D print on layer inciple of em, can be either poten Design" x parts contact and parts and par	ting is a property, as opposed family as opposed family and be fabricated to convention several and be an extended for the convention of t	ocess of joi sed to subt ta model, in the directly. The seconomical strong the directly and process of process of process of the best of t	ning mater ractive manitially general AM technology viable all reflecturing to dents with the Manufabuilding street stree	sials to make anufacturing erated using ologies have the nature of ed by these ternative to echnologies the concept acturing, and rategies and example of the concept acturing and the concept acturing actually actuall						

со	Course Outcomes	POs	PSOs
I COI	Apply the fundamental knowledge of the working principles and process parameters of additive manufacturing processes to manufacture the components.	1	1,2,3
CO2	Identify, compare and contrast alternative solution processes to select the best process of additive manufacturing processes and suggest suitable methods for building a component.		1,2,3

1 (1)-	Generate information through appropriate tests to improve or revise the design of suitable post processing operation based on product repair requirement.	1,2, 3, 4	1,2,3
	Recognize the need of analysis to good problem definition of ${f a}$ development of	1, 2, 3	1,2,3
	working model using additive manufacturing Processes.	1, 2, 3	1,2,3
CO5	Establish a relationship between measured data and underlying physical principles	1, 5	1,2,3
603	to Identify the need of design for additive manufacturing.	1, 3	1,2,3
CO6	Examine the relevant methods and techniques to Identify design constraints and	1 2 5	1,2,3
200	choose a metal additive manufacturing process.	1, 3, 5	1,2,3

													ı	1	
CO3 Ge	nerate table p	inform ost pro	nation ocessi	throug ng oper	h appro ation b	opriate ased c	tests in prod	to impi uct rep	ove or pair req	revise Juireme	the de ent.	esign of	1,2, 3, 4	1 1	.,2,3
CO3 Ge sui CO4 wo CO5 Est to cho CO6 CO1 CO2 CO3 CO4 CO5 CO6 CO6 CO7 CO1 CO2 CO3 CO4 CO5 CO6 CO0RSE AI CO2 CO3 CO4 CO5 CO1 CO2 CO3 CO4 CO5 CO1 CO2 CO3 CO4 CO5	cognize rking n	the r	eed o	of analy additive	sis to a	good p	roblen	n defin	ition o	f a dev	velopn	nent of	1, 2, 3	1	.,2,3
CO5 Est	ablish i	a relat / the n	ionshi eed o	p betwo	een me	asure ditive	d data manufa	and un acturin	derlyin g.	g physi	ical pri	nciples	1, 5	1	.,2,3
CO6 Exa	mine toose a	the rel	evant additiv	metho e manı	ds and ufactur	techn ing pro	iques t ocess.	o Iden	tify des	sign co	nstrair	nts and	1, 3, 5	1	.,2,3
BLOOM'S I	EVEL C)F THE	COU	RSE OU	TCOME	S	Dia	/- 1	al						
со	Re	memb	er	Unde	rstand		Apply	om s L	Ana	lyze	E	valuate	•	Crea	ite
CO1		(L1)		(1	L2)		<u>(L3)</u> √		<u>(L</u>	4)		(L5)		(L6	5)
CO2							/								
CO3						,	\		^						
CO4					/		$\overline{}$								
CO5							7	/	\ \						
CO6							/								
COURSE AI	RTICUL	ATION	MAT	RIX				\				1	T . T		
CO / POs	201	205	233	904	205	900	700	800	600	010	2011	9012	201	205	203
CO1	2		_							> _/	_^		1	2	1
CO2	2	1	3	1									1	2	1
CO3	3	1	1	1									1	2	1
CO5	1		_		1								1	2	1
CO6	3		2) Î								1	2	1
Average	2.2	1	2	1/	1_								1	2	1
COURSE CO	W, 2-MI	eaium T	, 3-HI	gn \			UNIT	-1							
CO3 CO4 CO5 CO6 Average Note: 1-Lor COURSE CO Introduction processes Prototyping Indirect Materials System for for the form for the	on to A and re g, Rapi anufact for Pro	dditive elevant d Tool curing.	Man prod ing. R	ufactur cess ph apid M	ing: Int ysics, anufac	roduct AM p turing on. Se	ion to rocess ; Indire	Powde chain, ect Pro	r Metal Applic cesses	lurgy, F cation - Indire a Part.	Revers level: ect Pro Challe	e engin Direct ototypi	proces ng. Indi	Differses -	rent AN - Rapid Fooling
System for	Prelim	inary S	electi	on, Pro	cess Pla	anning	and Co	ontrol. - 2	- '	•,		J - v		, -	ı- ·
Materials S rate, Evolu structure a	Science tion of nd mic	for Ad f non- rostru	Iditive equilib cture	Manuf orium s	facturir tructur	n g: Mu e, mio	ltifunct rostruc	ional a	nd grad studies	ded ma , Struct	terials ture p	in AM, roperty	Role of relatio	solidi nship	ficatio , Graii
Post Proce Accuracy Ir Non-therm	ssing on mprove al and	of Add ment, Therm	i tive I Aesth al Tec	Vlanufa etic Im _l hnique	cturing provem s,	Parts ent, P	: Supp	ort Ma tion for	terial F use as	Remova a Patte	al, Surf ern, Pr	face Te operty	xture In Enhance	nprov emen	ement ts usin
Additive N	lanufa	cturing	; Tech	nologie	es: Pow	der-ba	UNIT	- 3 √ proc	esses ii	nvolvin	g sinte	ering ar	nd melti	ng (se	electiv

CO / POs	P01	P02	εod	P04	50d	90d	20d	80d	60d	010d	110d	210d	PS01	PS02	EOSd
CO1	2		\wedge				\rangle /			> /			1	2	1
CO2	2/	1 /	3							/			1	2	1
CO3	2	1	2	1							^		/1	2	1
CO4	3	1	1				/						1	2	1
CO5	1		\ /		1			^					1	2	1
CO6	3		2	/	1								1	2	1
Average	2.2	1	2	1	1/		>						1	2	1

laser sintering, shaping, and electron beam melting involvement).

Directed Energy Deposition Processes: Process Description, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes.

Sheet Lamination Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.

Wire Arc Additive Manufacturing: Process, parameters, applications, advantages and disadvantages, case studies.

UNIT-4

Introduction to Design for Additive Manufacturing: Introduction to geometric modelling, Modelling of Synthetic curves like Hermite, Bezier and B-spline, Parametric Representation of freeform surfaces, Design freedom with AM, Need for Design for Additive Manufacturing (DFAM), CAD tools vs. DFAM tools, Requirements of DFAM methods, General Guidelines for DFAM, The Economics of Additive Manufacturing, Design to Minimize Print Time, Design to Minimize Post-processing

Design for Metal Additive Manufacturing: Powder Morphology, Powder Size Distribution, Material Characteristics, Designing to Minimize Stress concentrations, Residual Stress, Overhangs, shrinkage, warpage and Support Material, Design Guidelines for Wall Thickness, Clearance Between Moving Parts, Vertical Slots, Circular Holes, fillets, channels, vertical Bosses, circular pins, External Screw Threads and part positioning.

TEXT BOOKS

- 1. Ian Gibson, David W. Rosen and Brent Stucker, "Additive manufacturing technologies: rapid prototyping to direct digital manufacturing", Springer, 2010.
- 2. C.K. Chua, K.F. Leong and C.S. Lim, "Rapid prototyping: Principles and applications, 3rd Edition", World Scientific, 2010.
- 3. Diegel, Olaf, Axel Nordin, and Damien Motte "A Practical Guide to Design for Additive Manufacturing", Springer, 2020.

4. Redwood, Ben, Filemon Schoffer, and Brian Garret "The 3D Printing Handbook: Technologies, Design and Applications", 3D Hubs, 2017.

REFERENCE BOOKS

- 1. Patri K. Venuvinod and Weiyin Ma,"Rapid Prototyping: Laser-based and Other Technologies", Springer, 2004.
- 2. D.T. Pham and S.S. Dimov, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling", Springer 2001.
- 3. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley & Sons, 2006.
- 4. Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing, CRC Press, Second Edition, 2020.
- 5. C.P Paul and A.N Junoop, "Additive Manufacturing: Principles, Technologies and Applications", Mc Graw Hill, 2021.
- 6. Laroux K and Gillespie, "Design for Advanced Manufacturing: Technologies and Process", Mc Graw Hill, 2017.

Course Title	Design for M	anufacturing	and Ass	embly	Cours	se Type	Soft core		
Course Code	B20ERS612	Credits	3	3	С	Class		mester	
	TLP	Credits	Contact	Work	Total Number of		sment in		
	ILF	Credits	Hours	Load	Cla	asses			
Course	Theory	3	3	3	Per Se	emester	Weightage		
Structure	Practice	0	0	0	Theory	Dractical	IA	SEE	
	Tutorial	0	0	0	ineory	heory Practical		SEE	
	Total	3	3	3	39	0	50 %	50 %	

СО	Course Outcomes	POs	PSOs
1 CO1	Describe the importance of DFMA and its impact on industry in product design and material selection.	1,2,5	1,2
CO2	Apply the DFMA design guidelines for economical design and ease of manual assembly.	1,2,5	1,2
CO3	Implement DFMA in the design of high speed automatic and robot assembly.	1,2,5	1,2
CO4	Design of parts for feeding and orienting as per DFMA guidelines for accessibility.	1,2,3,5	1,2
CO5	Integrate CAD and DFMA and understanding its effect.	1,2,5	1,2
CO6	Discuss TRIZ and its relevance in industry.	1	1,2

		///	Bloom	's Level		>
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			1			
CO2			1			
CO3			\ \ \ \ \ \			
CO4			/ //			
CO5			1			
CO6		1				

COURSE O	/ERVII	ΕW													
Design for	manu	facturir	ng and	assem	nbly co	urse d	eals w	ith inti	oducti	on to [OFMA :	and sel	ection (of ma	aterials
product des	sign fo	r manu	ial asse	mbly a	ind also	cover	s desig	n for h	igh spe	ed auto	omatic	assemb	ly, robo	ot ass	sembly.
COURSE OF	covers (BJE CT I	s the D VES	FIVIA, C	.AD and	a IRIZ.										
1. To enab	ole the	stude	ents to	unde	rstand	gener	al desi	gn pri	nciples	for	manuf	facturab	ility, st	treng	th and
mechani	cal fac	tors, m	nechan	isms se	election	۱.							•1		
2. To provid	ie systi erials (ematic choice.	basic k	nowle	dge for	workii	ng prin	ciple, n	nateria	I, manu	ifacture	e, desigi	n possik	ole so	olutions
3. To enab	le the	stude	nts to	under	stand 1	the de	sign fe	atures	to fac	ilitate	machi	ning-dri	lls, mill	ling o	cutters,
keyways	, dowe	eling pr	ocedui	res.	necono	mical	decian								
5. To design	າ for e	conom	y, desig	gn for a	clamp-a	bility,	design	for ac	cessibil	ity and	modify	ying the	design	١.	
COURSE O	JTCON	ΛES (CO	Os)												
After the co	mplet	tion of	the cou	urse, th	ne stud	ent wi	ll be ab	le to:							
СО	1	L - '			Cou	rse Ou	tcome	<u> </u>					POs	P	PSOs
CO1 Desc	ribe tl	ne imp	ortanc	e ot DI	-MA ar	ia its i	mpact	øn ind	ustry ir	ı produ	ict des	ıgn and	1,2,5		1,2
COURSE ON Design for product des The course COURSE OF 1. To enable mechani 2. To provious and mat 3. To enable keyways 4. To formut 5. To design COURSE OF CO1 Design CO2 Apple asse CO3 Imple CO4 Design CO4 Design CO5 Integrate CO6 Disco BLOOM'S L	y the	DFM	·· A desig	gn guid	delines	for e	conom	ical d	esign a	ind ea	se of	manual	1,2,5		1,2
CO3 Impl	emen	t DFMA	in the	design	n of hig	h spee	d auto	matic a	nd rob	ot asse	mbly.		1,2,5		1,2
CO4 Desi	gn of p	parts fo	r feedi	ng and	orient	ing as	per DF	MA gu	idelines	for ac	cessibi	lity.	1,2,3,5	5	1,2
CO5 Integ	grate (CAD an	d DFM	A and ι	underst	andin	its eff	ect.					1,2,5		1,2
CO6 Disc	uss TR	IZ and	its rele	vance	in indu	stry.					^		1		1,2
BLOOM'S L	EVELO	OF THE	COURS	E OUT	COMES	· \	<u>/</u>		11	<u>/</u> ,	/				
co	R	emem	her	Unde	rstand		Annly	Jom s	Anal	vze	1 Fv	aluate		Crea	ite
		(L1)		(L	.2)		(L3)		(L4	(i)		(L5)		(L6	5)
CO1				/			V								
CO2						> \		\rightarrow							
CO3							> 🗸		_/						
CO4	_						<u> </u>		<u>/</u>						
CO5							<u>✓ √</u>		_/_						
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COURSE AF	LICOL		IVIAIKI												
CO/ POs)1)2	33	74	35	90	72	98	60	010	211	212	01	302	03
601	3	2	7	7	1	7	7	<u> </u>	7	<u> </u>	PC	7	3	2	<u>8</u>
L CO.I	3	3			1								3	3	
CO2	3	3			1								3	2	
CO2 CO3	2	2	1		1								3	3	
CO1 CO2 CO3 CO4	3	2			1								3	3	
CO2 CO3 CO4 CO5	3	3											3	2	
CO1 CO2 CO3 CO4 CO5	3	3											3	2.5	
CO1 CO2 CO3 CO4 CO5 CO6 Average	3 3 3	2.3	1.0		1.0							l l			1
CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	3 3 3 v, 2-M	2.3 ledium	1.0 , 3-High	n	1.0							<u> </u>	L		
CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	3 3 3 <i>x</i> , 2-M	2.3	1.0 , 3-High	n	1.0								1		
COURSE ON Design for product des	3 3 3 N, 2-M	2.3 ledium	1.0 , 3-High	/2021-2	1.0	21/2022	-23-25.0	6.22/20	23-24-10	0.06.23					

COURSE CONTENT

Unit-1

Introduction to DFMA and Selection of Materials: Meaning of design for manufacture and assembly, how DFMA works, advantages of applying DFMA in product design, typical DFMA case studies, overall impact of DFMA on industry, general requirements for early materials and process selection, selection of manufacturing processes, process capabilities, selection of materials, primary process/material selection.

Unit-2

Product Design for Manual Assembly: Introduction, General design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, effect of part symmetry, thickness, weight on handling time, effects of combinations of factors, effect of chamfer design on insertion operations, avoiding jams during assembly, application of the DFA methodology, types of manual assembly methods, assembly quality.

Unit-3

Design for High speed Automatic Assembly and Robot Assembly: Introduction, Design of Parts for High-Speed Feeding and Orienting—Example, Additional Feeding Difficulties, High-Speed Automatic Insertion, Analysis of an Assembly, General Rules for Product Design for Automation, Design of Parts for Feeding and Orienting, Product Design for Robot Assembly.

Unit- 4

Linking DFM with CAD and Introduction to TRIZ: Introduction: General Considerations for Linking CAD and DFMA, Geometric Representation Schemes in CAD Systems, Design Process in a Linked CAD/DFMA Environment, Expert Design and Cost Estimating Procedures, Introduction to TRIZ.

CASE STUDIES

1. Develop the dimensions with limits required for the components assembled together in their working condition of the Carrier Wheel Assembly.

- 2. Develop the dimensions with limits required for the components assembled together in their working condition of the Automobile Steering Box Assembly.
- 3. Develop the dimensions with limits required for the components assembled together in their working condition of the Plate Block Assembly.

TEXT BOOKS

- 1. George E, Dieter, "Engineering Design Material & Processing Approach", McGraw-Hill, 2nd Edition, 2015.
- 2. Geoffrey Boothroyd, "Hand Book of Product Design", Marcel and Dekken, 1st Edition, 2013.

REFERENCE BOOKS

- 1. Geoffrey Boothroyd, "Hand Book of Product Design", Marcel and Dekken, 1st Edition, 2013.
- 2. Geoffrey Boothroyd, Peter Dewhurst, Winston, "Product Design for Manufacturing and Assembly", CRC Press, 1st Edition, 2014.

Course Title		Turbomachin	ies		Cours	se Type	Soft Core		
Course Code	B20ERS613	Credits	:	3	С	lass	VI se	mester	
	TLP	Credits	Contact	Work	Total N	umber of	Accord	mont in	
	ILF	Credits	Hours	Hours Load		asses	Assessment in Weightage		
Course	Theory	3	3	3	Per Se	emester	vvei	giilage	
Structure	Practice	0	0	0	Thoony	Dractical	10	CEE	
	Tutorial	0	0	0	Theory	Practical	IA	SEE	
	Total	3	3	3	39	0	50 %	50 %	

COURSE OVERVIEW

Turboma work absproducin course of conversion and the conversion of the conversion o	chines a	ire rota	ry mac	chines t	that fall	unde	r the c	ategor	ies of 1	mechai	nical w	ork pro	oducin	g mach	ines or
work abs producin course o	orbing g machi n turbo	machine nes. Aii mach	es. Ma · comp inerv	ochines oressor deals	like hy s, hydr with te	dro to aulics ermino	urbines and of ologies.	s, stea ther fl class	m turb uid pur ificatio	ines, g mps ar n. prir	as turk e work nciples	oines a cabsor and e	re me bing r fficien	chanica machine icv of	al work es. The energy
conversion	n in pov	wer gen	eratinį	g or ab	sorbing	mach	ines.			, ,	•			,	o,
1. To int	oduce v	vorking	princi	ples, cl	assifica	tion of	fturbo	machi	nes.						
2. To def	ne dim ve Euler	ensionle Turbin	ess par e equa	ramete ntion, d	rs for a egree o	gener of reac	alized t tion an	fluid flo d utiliz	ow thro ation f	ough tu actor c	irbo ma of axial	flow, r	s. adial fl	ow and	l mixed
Turbo	nachine	·S.													
4. To der	ve equa	tions fo	r work	done,	power	develo	ped ar	nd effic	iencies	of imp	oulse a	nd reac	tion st	team tu	irbines.
COURSE	OUTCO	MES (CC	s)												
After the	comple	tion of 1	he cou	urse, th	ne stude	ent wi	l be ab	le to:							- BSG
CO	duce t	he con	cents	of tur	Cou bomact	rse Ou	and co	s mpare	with	positi	ve disi	olacem	ent	POs	PSOs
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CO2 turb	omachii	nes.	e nov	ver de	velopor	Land	efficie	ncies	of avial	and r	adial f	10w +11	rho 1	,2,3,5	1,2
CO3 mad	nines.	ork don	ε, ρον	ver ue	veloped	and	emere	incies () axiai	and i	adiai i	10w tu	100	1,2	1,2
CO4 Ana	yse the	perforn	nance	of 50%	reactio	n pov	ver gen	eratin	g turbo	machi	nes.			1,2	1,2
CO5 Com	pute thomachi	ne perfo nes.	rmano	ce para	imeters	of a	xiál flo	w and	radial	flow	oower	absorb	oing	1,2,3	1,2
CO6 effic	pret th	e veloc Impuls	ity tria	angles reactio	and es n stean	timate 1 turb	the f	orces,	power	devel	oped,	and bl	ade	1,2,3	1,2
BLOOM'S	LEVELO	OF THEC	OURS	E OUTO	COMES		BÍ	oom's	Level						
со	R	tememk	er	Unde (L	rstand .2)		Apply (L3)		Anal	lyze 4)	Ev	valuate (L5)		Crea (L6	te)
CO1				`	/ \		/								
CO2							1/		/						
CO4						<	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \								
CO5															
CO6							√								
COURSE	ARTICUI	ATION	MATR	RIX									1	1	
CO/ PO	P01	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	2							_		_		2	1	
CO2	3	2	1		1								2	1	
CO3	3	3											2	1	
CO4	3	3	1										2	1	
CO6	3	3	1										2	1	
Average	3	2.5	1		1								2	1	
Note: 1-l	ow, 2-N	ledium,	3-High	h			•	•	•	•	•	•	•		
Ref: BOS/S	лЕ/ВМЕ-:	2020-21-2	0.06.20	/2021-2	2-05.06.2	1/2022	-23-25.0	6.22/20	23-24-10	0.06.23					

	Bloom's Level								
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)			
CO1		√							
CO2			/ •/\						
CO3			//						
CO4			V						
CO5			√						
CO6			✓						

CO/ POs	PO1	P02	PO3	P04	PO5	90d	P07	PO8	60d	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	2											2	1	
CO2	3	2	1		1								2	1	
CO3	3	3											2	1	
CO4	3	3											2	1	
CO5	3	3	1										2	1	
CO6	3	3	1										2	1	
Average	3	2.5	1		1								2	1	

COURSE CONTENT

Unit-1

Introduction to Turbomachines: Definition of a Turbo machine; parts of a Turbo machine, Classification, Comparison with positive displacement machine, Dimensionless parameters and their physical significance; Specific speed; Unit and specific quantities, model studies, Numerical.

Unit-2

Fundamentals of Energy Conversion in Turbomachines: Euler's turbine equation and its alternate forms, Components of energy transfer, General expression of degree of reaction, Relation between degree of reaction and utilization factor, Construction of velocity triangles for different values of degree of reaction for axial flow turbines, Numerical.

Energy Transfer in Turbomachines: Velocity diagrams and Condition for Maximum Utilization factor in axial flow Impulse and 50% reaction machines, Numerical.

Unit-3

Axial Flow Power Absorbing Turbo Machines: General analysis of axial flow Compressors, velocity triangles and general expression for degree of reaction, Numerical.

Radial Flow Power Absorbing Turbomachines: General analysis of Centrifugal flow Compressors and pumps, velocity triangles and general expression for degree of reaction, Theoretical head – capacity relationship, Types of centrifugal pump impeller, Numerical.

Unit-4

Impulse Steam turbines: Classification, Need and methods of compounding, single stage impulse turbine, condition for maximum blade efficiency, Numerical.

Reaction Steam turbines: Parsons's steam turbine, condition for maximum utilization factor, Numerical.

CASE STUDIES:

1. Prepare a report on any Compressors/Pumps/Blowers used in industry by mentioning following details: Make and specifications, operating conditions, construction, working principle, and applications.

- 2. Prepare a report on any Thermal power station by mentioning the following details: Make and
- 3. Specifications, type and of number of turbines, capacity of power generation, working principle, operating conditions and applications.
- 4. Prepare a report on applications of Steam turbines by literature survey.

TEXT BOOKS

1. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion, Volume III, Turbo machinery", New Age

International Publishers, 2nd Edition, 2013,

2. S. M. Yahya," Turbines, Compressors & Fans", Tata McGraw Hill Co. Ltd., 4th Edition, 2002.

REFERENCE BOOKS

- 1. D. G. Shepherd, "Principals of Turbomachines", The Macmillan Company, 2nd Edition, 2002.
- 2. S. L. Dixon, "Fluid Mechanics & Thermodynamics of Turbomachines", Elsevier, 7th Edition, 2014.
- 3. B.K.Venkanna "Fundamentals of Turbomachinery", PHI New Delhi, 2nd Edition, 2013.

JOURNALS/MAGAZINES

- 1. https://www.researchgate.net/topic/Steam-Turbine/publications
- 2. https://www.sciencedirect.com/topics/engineering/steam-turbines

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc22_me31/preview

Course Title	Electric	c and Hybrid	Course Type	Soft Core	
Course Code	B20ERS614	Credits	3	Class	VI semester
Course	TLP	Credits	Contact Work	Total Number of	Assessment in

Structure			Hours	Load	Cla	isses	Wei	ghtage
	Theory	3	3	3	Per Se	emester		
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	THEOLY	Fractical	IA	JLL
	Total	3	3	3	39	0	50 %	50 %

Struct	ure	Γ		Hours	load	Cla	ISSES	\\/a	vightage
Struct	uie	Theory	3	3	3	Per Se	mester	VV¢	eigiitage
		Practice	0	0	0	1 61 30	Inester		
		Tutorial	0	0	0	Theory	Practical	IA	SEE
		Total	3	3	3	39	0	50 %	50 %
COURSE ON This course the field of electric mo	'ERVIEW is targeti Electric a	ng students and Hybrid so offers in	who wish to Vehicles and	oursue rese upcoming r edge about	earch & d narket fo	evelopme or retrofit g of an Ele	nt in indust of existing ectric Vehic	ries or hig IC engine	gher studies i vehicles wit ering study o
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	Bloom's Level										
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)					
CO1		✓									
CO2		✓									
CO3			✓								
CO4			✓								
CO5		✓									

CO6				✓											
COURSE AR	COURSE ARTICULATIONMATRIX														
CO/ POs	P01	P02	ЕОА	P04	P05	90d	704	80d	60d	PO10	PO11	P012	PSO1	PS02	PSO3
CO1	3					2	2						2		
CO2	3												3		
CO3	3												2		
CO4	3												3		
CO5	3	1											2		
CO6	2												3		
Average	2.8	1				2	2						2.5		

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Sustainable Transportation, A Brief History of EHVs, Need of EHV technology, Architectures of EHVs, social and environmental importance of hybrid and electric vehicles, Challenges and Key Technology of EHVs.

EHV Fundamentals: Basics of vehicle performance, vehicle power source characterization, transmission characteristic and mathematical models to describe vehicle performance

Unit-2

Hybrid Electric Drive-trains: Basic Architecture of Hybrid Drive Trains, Energy Savings Potential of Hybrid Drivetrains, Hybrid drive train configurations- series configuration, Parallel configurations, Series-Parallel configurations and complex configurations, power flow control in hybrid drive-train topologies

Basic Architecture of Electric Drive Trains: Electric Vehicles drive train configurations, Introduction to various electric drive-train topologies, Electric Vehicle (EV) drivetrain Alternatives Based on Drivetrain Configuration, Electric Vehicle (EV) Drivetrain Alternatives Based on Power Source Configuration.

Unit-3

Electric Propulsion unit: Electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, introduction to Permanent Magnet Motors. Control Systems for the EHV and EVs: In vehicle networks- CAN, Energy Management Strategies: Energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

Unit-4

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery Parameters, Different types of Battery used in EHVs, Battery based energy storage and its analysis, Problems associated with battery systems in EHVs, Temperature controlling methods, advanced battery technologies.

Fuel Cells: Fuel Cell Characteristics - Fuel Cell Types – Alkaline Fuel Cell - Proton Exchange Membrane - Direct Methanol Fuel Cell - Solid Oxide Fuel Cell- Hydrogen Storage Systems- Reformers - Fuel Cell EV - Super and Ultra Capacitors - Flywheels.

CASE STUDIES

- 1. Advances in battery health monitoring and prognostics technologies for electric vehicle (EV) safety and mobility
- 2. Energy storage systems for electric vehicle applications: issues and challenges
- 3. Design of a hybrid electric vehicle powertrain for optimum performance parameters
- 4. A comprehensive review on estimation strategies used in hybrid and battery electric vehicles
- 5. Data-driven reinforcement learning—based real-time energy management system for plug-in hybrid electric vehicles
- 6. Impacts assessment of plug-in hybrid vehicles on electric utilities and regional Indian power grids

TEXT BOOKS

- 1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 3rd Edition, 2021.
- 2. M. Ehsani, Y. Gao and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press London, 3rd Edition, 2019.

3. James Larminie, John Lowry, "Electric Vehicle Technology", Wiley Blackwell, 2nd Edition, 2003.

REFERENCE BOOKS

- 1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 3rd edition, Wiley, 2003
- 2. Seth Leitman, Bob Brant, "Build Your Own Electric Vehicle" McGraw-Hill, 3rd Edition, 2013.
- 3. Chris Mi, M A Masrur, D W Gao, "Hybrid Electric Vehicles Principles and applications with practical perspectives", 4th edition, Wiley, 2011
- 4. C.C Chan, K.T Chau, "Modern Electric Vehicle Technology", Oxford University Press Inc., New York, 1st Edition, 2001

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/book/9780444535658/electric-and-hybrid-vehicles
- 2. https://www.scimagojr.com/journalsearch.php?q=11600153305&tip=sid

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/108/103/108103009/
- 2. https://www.edx.org/course/electric-cars-technology
- 3. https://www.classcentral.com/course/edx-hybrid-vehicles-10285

Course Title	Production ar	nd Operation	s Management	Course Type	Soft core
Course Code	B20ERS615	Credits	3	Class	VI semester
Course	TLP Theory	Credits 3	Contact Work Hours Load 3 3	Total Number of Classes Per Semester	Assessment in Weightage
Structure	Practice Tutorial	0	0 0	Theory Practical	IA SEE
	Total	3	3 3	39 0	50 % 50 %

COURSE OVERVIEW

This course provides insight in to various fundamental aspects of production planning and forecasting techniques. It also presents various decision making techniques, aggregating and master production scheduling methods, various inventory monitoring and controlling methods are discussed. Handling dependent demand items and techniques for MRP and continuous improvement methods are included. The course contains routing methods and supply chain managements. Quantitative techniques are heavily used in analyzing operations and improving their efficiency and effectiveness. Overall objective of this course is to manage production systems in a better way

COURSE OBJECTIVES

- 1. To acquire the knowledge of production planning process and its functions
- 2. To study the fundamentals of Inventory management
- 3. To provide knowledge about MRP and ERP systems
- 4. To introduce the concepts of purchasing and supply chain management

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes	POs	PSOs
1 CO1	Describe the concept of operations management and apply the decision models to solve real time problems.	1,2,3	1,2,3
1 (.()/	Recognize the role of operations management in business functions and organizations strategic planning.	1,2,3,11	1,2,3
CU3	Formulate and analyze aggregate planning and master production schedule concepts.	1,2,11	1,2,3

CO4	Analyze inventory models for a range of operations.	1,2,11	1,2,3
CO5	Evaluate a selection of frameworks used in the design and delivery of operations using MRP and ERP	1,2,3,11	1,2,3
CO6	Summarize the concepts of routing, purchasing and SCM.	1,2,3,11	1,2,3

CO4 A	nalyzo	e invento	ory mod	lels for	a range	of ope	rations					1,2	2,11	1,2,3
CO5	Evalua	ate a sele	ection o	f frame	works u	sed in	the de	sign an	d delive	ery of o	peration	s 1,2,	3,11	1,2,3
CO6 Si	using	arize the	concen	ts of ro	uting, pi	ırchas	ing and	I SCM.				1.2.	3.11	1.2.3
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							Blo	om's L	evel					
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Introduc Control, and cont Forecast	COURSE CONTENT Unit-1 Introduction to Process Planning, Control and Forecasting: Definitions, Objectives of production Planning and Control, Functions of production planning and control, Types of production, Organization of production planning and control. Forecasting: Importance of forecasting, Types, principles, qualitative and quantitative methods, time series nethods, Exponential smoothing, Regression methods, numerical. Unit-2													
Operation methodo Aggregati Aggregati	Operations Decision: Introduction, Characteristics of decisions, framework for Decision Making, Decision methodology, Decision supports systems, Economic models-Break-even analysis in operations, numerical. Aggregate Planning and Master Scheduling: Planning and Scheduling, Objectives of Aggregate Planning, Aggregate Planning Methods, Master Scheduling Objectives, Master Scheduling Methods, numerical. Unit-3													
Inventor inventor VED anal	ies, ir	nventory	costs,				-			-	-			nctions of C analysis
MRP & E	-			IRP & EI	RP, JIT in	vento	ry, MRP	Logic,	Capacit	y Mana	gement,	CRP a	ctivitie	s. Concept
of contin								_			,			·
Routing affecting		-	_	ition, F	Routing	& Disp	Unit-4 patching		edure, F	Route s	heets, B	Bill of r	materi	al, Factors
							-23-25.06							

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CO2	3	3	1			/					1		3	1	1
CO3	3	2	^								1		3	1	1
CO4	3	3									/1		3	1	1
CO5	3	2 /	1					$\wedge \setminus$			1		3	1	1
CO6	3	2	1								1		3	1	1
Average	3	2.3	1			/	/	/ ,			1		3	1	1

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Supply Chain Mana	agement: Introd	duction to su	upply chai	n manag	gement- A	pproaches t	o purchase	e and supply
chain management,	Bull whip effect	t, make or bu	ıy decision	, e-Proc	urement, \	Vender deve	lopment, v	endor rating
methods, simple nu	merical.							
1 Forecasting of CS	D (Critical Snare	Parts for an	Indian Aut	tomohile	a Industry			
2. SAP Successful st	orv of developin	raits for all	are in Mar	ufacturi	ing Industry	v		
3. Inventory Manag	ement - "A case	study at Var	ious Manı	ıfacturin	ng Sectors"	'		
4. Implementation of	of supply chain r	nanagement	at various	global e	enterprise	- Honda / T\	/S / Motor	ola /Amazon
/ Flipkart.								
TEXT BOOKS								
1. Samuel Eilon, "Ele	ements of Produ	iction Planni	ng and Co	ntrol", 1 robleme	" ard Edition,	Universal Pu	iblishing Co	orp., 1999.
REFERENCE BOOKS	operations iviand	agement me	eory and P	robieiris	, 5 Euiti	on, wicdraw	-пііі 3, 196	<i>/</i> .
1. P Rama Murthy, '	"Production and	Operations	Managem	ent", 1 st	Edition, N	lew Age, 200)2	
2. Baffa & Rakesh Sa	arin, "Modern P	roduction / 0	Operations	Manag	ement", 8¹	th Edition, Jo	hn Wiley &	Sons, 2002.
3. S.N. Chary, "Oper	rations Manager	ment", 1 st Ed	ition, TMF	J, 1996				
4. Pannerselvam R,	"Production and	d Operation I	Manageme	ent", PH	l publication	ons, 2 nd Editi	ion	
5. Everett E. Adams	, Ronald J. Ebert	"Production	and Oper	ations N	/lanageme	nt", Prentice	e Hall of Ind	dia
Publications, Four	rtn Ealtion ZINES							
1 https://www.tan	dfonline com/to	oc/tnrs20/cu	rrent- Inte	rnationa	al iournal d) of Production	n research	
2. https://www.em	erald.com/insig	ht/publication	n/issn/01	44-3577	Internat	ional journa	l of operat	ion and
nraduation mana		,	,,,,,,,,,		\	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
production mana	agement							
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SWAYAM/NPTEL/N 1. https://nptel.ac 2. https://nptel.ac Course Title Course Code	Automass B20ERS621	0107141 0107238 ation in Man	nufacturin	B .	Cours	se Type	Soft VI sei	: Core mester
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CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov COURSE CO Introduction manufactur manufactur manufactur Basic Eleme versus Disco Manufactur Engineering Basic conce production Elements of automation Ref: BOS/SME	n: Pro ing :∽	ductio	n Syst	em Fac	ilities, A	Nutom	ation o	tetinit	on, typ	e and	Import	ance of	auto	matior	in th
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			Bloom	's Level		
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CO5	3				2			\wedge					2	2	
CO6	3				2								2	2	
Average	2.8	2			2							·	2	2	

Unit-3

Group Technology and Flexible Manufacturing Systems: Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems (FMS) and its components, FMS Applications & Benefits, FMS Planning & Implementation Issues. Case studies.

Intelligent Manufacturing Systems: Introduction, need of intelligent manufacturing system & applications.

I Init_/I

Inspection Technologies: Automated Inspection, Coordinate Measuring Machines Construction, operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Technologies, Case studies on automated inspection.

Industrial Control Systems: Programmable Logic Controllers (PLC) based control system, programming languages & instruction set, ladder logic, functional blocks, structured text, and their applications with various automation examples. Human Machine Interface (HMI), Supervisory Control and Data Acquisition System (SCADA), motion controller, smart sensors, RFID technology and its application, machine vision and control applications.

Demonstration: Ladder logic programming using ISP Delta software.

CASE STUDIES

- 1. Study on lean manufacturing and agile manufacturing, Toyota Production System.
- 2. Study on Flexible Manufacturing Process, Group Technology and intelligent manufacturing.
- 3. Study on automated inspection techniques in different industries.

TEXT BOOKS

- 1. M. P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education. 5th Edition, 2019.
- 2. John R. Hackworth & Frederick D. Hackworth Jr, "Programmable Logic Controllers Programming Methods and Applications", Pearson, 2011.

3. Rao, P. N., "CAD/CAM Principles and Applications", Tata McGraw Hill, New Delhi, 2nd Edition, 2010.

REFERENCE BOOKS:

- 1. Georges Friedmann, "The Anatomy of Work: Labor, Leisure and the Implications of Automation", Hassell Street Press, 2021.
- 2. Viswanandham, "Performance Modeling of Automated Manufacturing Systems", Prentice Hall India Learning Private Limited, 2015.
- 3. Krishna Kant, "Computer Based Industrial Control", Prentice Hall India Learning Private Limited, Revised 2nd Edition 2011.
- 4. Nakra, B. C., "Theory and Applications of Automatic Controls", New Age International Publishers, Revised 2nd Edition, 2014.
- 5. John W. Webb & Ronald A. Reis, "Programmable Logic Controllers Principles and Applications", Pearson Education, 5th Edition, 2008.

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/search?qs=automation
- 2. https://asmedigitalcollection.asme.org/manufacturingscience
- 3. https://www.industrialautomationindia.in/

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/112103293
- 2. https://www.digimat.in/nptel/courses/video/112104288/L01.html

Course Title	Roboti	c Systems Kiı	nematics	Course Type	Soft Core
Course Code	B20ERS622	Credits	3	Class	VI semester
Course	TLP	Credits	Contact Work	Total Number of	Assessment in

Structure			Hours	Load	Cla	asses	Wei	ghtage
	Theory	3	3	3	Per Se	emester		
	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	THEOLY	Fractical	IA	JLL
	Total	3	3	3	39	0	50 %	50 %

СО	Course Outcomes	POs	PSOs
CO1	Understand the fundamentals of robotic systems and their terminologies.	1	1,2
CO2	Analyze direct kinematics of manipulator configurations.	1,2	1,2
CO3	Design manipulator configuration and end-effector for industrial applications.	1,2,3	1,2
L CO4	Apply the knowledge of path planning to develop robots to perform basic operations.	1,2	1,2
CO5	Develop the part program for various robotic applications.	1,2,3	1,2
CO6	Understand the role of vision system for the robot applications.	1,2	1,2

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COURSE ARTICULATIONMATRIX	CULATIONMATRIX	CO5 CO6 OURSE ARTICULATIONMATRIX	COURSE ARTICULATIONMATRIX		CO1 3	CO1 3 3 1 3 1	CO1 3 CO2 3 3 1 3 1	CO1 3 1 CO2 3 3 1 CO3 3 2 3 1	CO1 3 1 CO2 3 3 1 CO3 3 2 3 1	CO1 3 1 CO2 3 3 1 CO3 3 2 3 1 CO4 2 1 3 1	CO1 3 1 CO2 3 3 1 CO3 3 2 3 1 CO4 2 1 3 1 CO5 3 2 1 3 1	CO1 3 CO2 3 3 1 CO3 3 CO4 2 1 3 CO5 3 2 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1	CO1 3 1 CO2 3 3 1 CO3 3 2 3 1 CO4 2 1 3 1 CO5 3 2 3 1 CO6 3 1 3 1	CO1 3 1 CO2 3 3 1 CO3 3 2 3 1 CO4 2 1 3 1 CO5 3 2 3 1 CO6 3 1 3 1
CO/ POs 10 20 20 20 20 20 20 20	CULATIONMATRIX TO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CO5	CO/ POs T	CO1 3			CO2 3 3 1 3 1	CO2 3 3 1 3 1 CO3 3 2 3 1	CO2 3 3 1 CO3 3 2 CO4 2 1	CO2 3 3 1 CO3 3 2 3 1 CO4 2 1 3 1	CO2 3 3 1 CO3 3 2 CO4 2 1 CO5 3 2 1	CO2 3 3 1 CO3 3 2 CO4 2 1 CO5 3 2 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1	CO2 3 3 1 CO3 3 2 3 1 CO4 2 1 3 1 CO5 3 2 1 3 1 CO6 3 1 1 3 1	CO2 3 3 1 CO3 3 2 CO4 2 1 CO5 3 2 1 CO6 3 1 1 CO6 3 1 1 CO6 3 1 1
COURSE ARTICULATIONMATRIX CO/ POS	CULATIONMATRIX TO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CO5 CO6 OURSE ARTICULATIONMATRIX CO/ POs	CO/ POS	 - - - 						CO4 2 1 3 1 3 1	CO4 2 1 3 1 CO5 3 2 1 3 1	CO3 3 2	CO3 3 2 CO4 2 1 CO5 3 2 1 3 1 CO6 3 1 1 3 1 1 3 1 1 3 1 1 3 1	CO3 3 2 CO4 2 1 CO5 3 2 1 3 1 CO6 3 1 1 3 1 1 3 1 1 3 1 1 4 1 1 5 1 1 6 1 1 7 1 1 8 1 1 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 1 1 1 3 1 1 4 1 1 1 5 1 1 1 6 1 1
CO/ POS	CULATIONMATRIX TO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CO5 CO6 OURSE ARTICULATIONMATRIX CO/ POs	CO/ POS	CO2 3 3 1 3 1 3 1			(03 3 2 3 1			COT 2 1 3 1	CO5 3 2 1 3 1 3 1 3 1	CO5 3 2 1 3 1 3 1	CO5 3 2 1 3 1 CO6 3 1 1 3 1	CO5 3 2 1 3 1 CO6 3 1 1 3 1
COURSE ARTICULATIONMATRIX CO/ POS	CULATIONMATRIX TO 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	CO5 CO6 CO6 CO7 CO8 CO7 CO8 CO7 CO8 CO7 CO8 CO7 CO8	COURSE ARTICULATIONMATRIX CO/ POs	CO2 3 3 1 CO3 3 2 CO4 2 1	CO3 3 2 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3	CO3 3 2 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3				. CO5 3 2 1			CO6 3 1 1 1 3 1	CO6 3 1 1 3 1 3 1
COURSE ARTICULATIONMATRIX CO/ POS	CULATIONMATRIX TO RO	CO5 CO6 OURSE ARTICULATIONMATRIX CO/ POS Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q	CO/ POS	CO2 3 3 1 CO3 3 2 CO4 2 1 CO5 3 2 1 3 1 3 1 3 1 3 1	CO3 3 2 3 1 3 1 CO4 2 1 3 1 3 1 CO5 3 2 1 3 1	CO3 3 2 CO4 2 1 CO5 3 2 1 3 <t< td=""><td>CO4 2 1 3 1 3 1 3 1</td><td>CO5 3 2 1 3 1 3 1</td><td>' CO5 3 2 1 </td><td></td><td></td><td>CO6 3 1 1 </td><td></td><td></td></t<>	CO4 2 1 3 1 3 1 3 1	CO5 3 2 1 3 1 3 1	' CO5 3 2 1			CO6 3 1 1		
COURSE ARTICULATIONMATRIX CO/ POS	CULATIONMATRIX O	CO5 CO6 CO6 CO7 CO8 CO7 CO8 CO7 CO7 CO8 CO7 CO8 CO7 CO8 CO7 CO8	COURSE ARTICULATIONMATRIX CO/ POS	CO2 3 3 1 CO3 3 2 CO4 2 1 CO5 3 2 1 3 1 CO5 3 1 CO6 3 1 1 3 1 1 3 1 1 3 1 1 3 1 1 3 1	CO3 3 2 CO4 2 1 CO5 3 2 CO6 3 1 1 1 1 3 </td <td>CO3 3 2 CO4 2 1 CO5 3 2 CO6 3 1 1 1 1 3 <!--</td--><td>CO4 2 1 3 1 CO5 3 2 1 3 1 CO6 3 1 1 3 1</td><td>CO5 3 2 1 3 1 CO6 3 1 1 3 1</td><td>CO5 3 2 1 3 1 CO6 3 1 1 3 1</td><td>CO6 3 1 1 3 1</td><td>' CO6 3 1 1 </td><td></td><td></td><td>Average 2.8 1.8 1 3 1 </td></td>	CO3 3 2 CO4 2 1 CO5 3 2 CO6 3 1 1 1 1 3 </td <td>CO4 2 1 3 1 CO5 3 2 1 3 1 CO6 3 1 1 3 1</td> <td>CO5 3 2 1 3 1 CO6 3 1 1 3 1</td> <td>CO5 3 2 1 3 1 CO6 3 1 1 3 1</td> <td>CO6 3 1 1 3 1</td> <td>' CO6 3 1 1 </td> <td></td> <td></td> <td>Average 2.8 1.8 1 3 1 </td>	CO4 2 1 3 1 CO5 3 2 1 3 1 CO6 3 1 1 3 1	CO5 3 2 1 3 1 CO6 3 1 1 3 1	CO5 3 2 1 3 1 CO6 3 1 1 3 1	CO6 3 1 1 3 1	' CO6 3 1 1			Average 2.8 1.8 1 3 1
COORSE ARTICULATIONMATRIX CO/ POS Total control co	CULATIONMATRIX TO Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q	CO5 CO6 OURSE ARTICULATIONMATRIX CO/ POs CO1 3 3 1	COURSE ARTICULATIONMATRIX CO/ POS	CO2 3 3 1 CO3 3 2 3 1 CO4 2 1 3 1 CO5 3 2 1 3 1 CO6 3 1 1 3 1 Average 2.8 1.8 1 3 1	CO3 3 2 CO4 2 1 CO5 3 2 1 3 1 CO5 3 2 1 CO6 3 1 1 Average 2.8 1.8 1	CO3 3 2 3 1 CO4 2 1 3 1 CO5 3 2 1 3 1 CO6 3 1 1 3 1 Average 2.8 1.8 1 3 1	CO4 2 1 CO5 3 2 1 CO6 3 1 1 Average 2.8 1.8 1	CO5 3 2 1 3 1 CO6 3 1 1 3 1 Average 2.8 1.8 1 3 1	CO5 3 2 1 3 1 CO6 3 1 1 3 1 Average 2.8 1.8 1 3 1	CO6 3 1 1 3 1 Average 2.8 1.8 1 3 1	CO6 3 1 1 3 1 Average 2.8 1.8 1 3 1	Average 2.8 1.8 1 3 1	' Average 2.8 1.8 1 3 1	
	V	CO5 / /		COURSE ARTICULATIONMATRIX CO/ POs	CO/ POs 1	CO/ POs	CO/ POS	CO/ POS	CO/ POS	COURSE ARTICULATIONMATRIX CO/ POS	CO/ POS	COURSE ARTICULATIONMATRIX CO/ POS	CO/ POS	CO/ POS
CO6		CO5	CU6 /	CO/ POS 10 20 80 40 50 90 00 01 01 01 02 03 03 03 03 03 03 03	CO/ POs	CO/ POs	CO/ POs Total Control Total Control<	CO/ POs Total Control Total Control<	CO/ POs Till	CO/ POs Total Control Total Control<	CO/ POs Tilde <	CO/ POS Q </td <td>CO/ POS TI Q<</td> <td>CO/ POS Q<!--</td--></td>	CO/ POS TI Q<	CO/ POS Q </td
COURSE ARTICULATIONMATRIX	CULATIONMATRIX	CO5 CO6 OURSE ARTICULATIONMATRIX	COURSE ARTICULATIONMATRIX		CO1 3 1 1 1 1 1 1 1 1 1	CO1 3 3 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3	CO1 3 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1	CO1 3 a	CO1 3	CO1 3 A	CO1 3 A	CO1 3 a	CO1 3 a	CO1 3 a

CO/ POs	PO1	P02	PO3	PO4	PO5	90d	PO7	PO8	P09	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3												3	1	
CO2	3	3	1										3	1	
CO3	3	2											3	1	
CO4	2	1											3	1	
CO5	3	2	1										3	1	
CO6	3	1	1										3	1	
Average	2.8	1.8	1										3	1	

COURSE CONTENT

Unit-1

Introduction: Fundamental laws of Robotics, Dier History of Robotics, Classification of Robots, robot anatomy and configuration, Robot Evaluation: resolution, repeatability and accuracy of robot. Numerical.

Structure of Robots: Types of Joints, Representation of Joint, Degrees of Freedom and workspace.

Unit-2

Spatial Description: Description of position and orientation of a rigid body, Types of Frames, Euler angle representation for xxy, Xxy Trames.

Spatial Description: Description of position and orientation of a rigid body, Types of Frames, Euler angle representation of Transformations, Rotation, Scaling (numerical with real applications), Homogeneous representation of Transformations, Ropocities of rotation mancies and combined transformations (numerical with real applications).

D-H Convention: Forward Kinematics, Implementation of D-H convention and obtaining transformation matrices for 3R Manipulator. Design and simulation of different types of robot like ABB, KLIKA, FANUC robots models using Robot Smillation Software.

Unit-3

Robot End Effectors: Types of end effectors, Mechanical gripper, yield of the Convention of the Conventi

Course Title	Refrigerat	ion and Air (Condition	ing	Cours	se Type	Soft	Core
Course Code	B20ERS623	Credits		3	С	lass	VI se	mester
	TLP	Credits	Contact	Work	Total N	umber of	٨٠٠٥٠	ment in
	ILF	Credits	Hours	Load	Cla	asses		ghtage
Course	Theory	3	3	3	Per Se	emester	VVCI	giilage
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	Theory	Fractical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

CLAVANA - / /								
SWAYAM/NPTEL/M 1. https://onlinecour Course Title Course Code Course Structure COURSE OVERVIEW This course provides thermodynamic cycle various components estimation of the carefrigeration and air work in R&AC indust COURSE OBJECTIVES 1. To understand valued to a component of the carefrigeration and air work in R&AC indust course objectives 1. To understand valued to a component of the carefrigeration and winter of the knowledge of the course of the cour	OOCs: ·ses.nptel.ac.in/	noc21 me	76/preview					
		_	, i					
Course Title	Refrigerat	ion and Air	Condition	ing	Cours	е Туре	Soft	Core
Course Code	B20ERS623	Credits	3	}	Cl	ass	VI se	mester
	TLP	Credits	Contact	Work	Total N	umber of	Assess	ment in
Course	Theory	3	3	3	Per Se	emester	Wei	ghtage
Structure	Practice	0	0	0		ester		
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %
COURSE OVERVIEW				\		L		•
This course provides	the knowledge	on refrige	ration and	air cond	tioning sy	stem. Unde	rstand the	concept of
thermodynamic cycle	es applicable to	produce co	oling effect	through	various s	ystems. It giv	es inform	ation about
various components	and working fl	uids used ir	n various re	efrigerat	ion systen	ns. It also pr	ovides kno	owledge on
estimation of the ca	pacity of the p	lant for par	ticular coo	ling app	lication. T	his course e	nlightens	the uses of
refrigeration and air	conditioning in	various re	al time app	olication	s. This cou	urse provide	s basic kn	owledge to
work in R&AC indust	ries.							
1. To understand use	i rique rofrigarati	on cycles a	nd rofrigor	ation cur	toms			
2. To acquire the key	nous reinigerati	igerante an	d thair offe	acte and	various co	mnonents	sed in DQ./	1C system
3. To understand pri	ncinles of nsych	rometry an	d develop t	he skills	to estima	te cooling lo	ad and hea	ating load for
summer and wint	er air condition	ing	ducvelop .	ine skins	to estima	te coomig io	aa ana nee	ating load for
4. To gain the knowl	edge on how re	efrigeration	and air co	/ nditionir	ng will be	useful in do	mestic and	l commercia
application								
5. To expose the stu	dents to field o	of refrigerat	ion and air	conditio	ning, so t	hat they car	get an op	portunity to
work in R&AC indu	ustries.							
COURSE OUTCOMES	(COs)							
After the completion	of the course,	the student	t will be abl	e to:				
CO		Course (2				POs	PSOs
			Jutcomes				1	
CO1 Explain workii	ng of refrigerati	on and air o	conditionin	g system	ıs.		7	1,
CO1 Explain workin	ng of refrigeratine application of	on and air of refrigera	conditionin nts and w	g system	s. f compon	ents used i	1 1 7	1,
CO1 Explain workin CO2 Summarize the refrigeration a	ng of refrigeratine application of application of application of application of application of the applicati	on and air of refrigera ning systen	conditionin nts and wens.	g system orking o	f compon	ents used i	1,7	1,
CO1 Explain workin CO2 Summarize the refrigeration are cost Evaluate the	ng of refrigeratine application of application of and air-condition performance of	on and air of of refrigera ning systen of vapour	conditionin nts and wons.	g system orking o	f compon	ents used in	1,7 r 1.2	1,
CO1 Explain working CO2 Summarize the refrigeration at Evaluate the refrigeration of the refr	ng of refrigeration of application of and air-condition of performance of systems.	on and air of refrigeral aning system of vapour of	conditionin nts and wons.	g system orking o n, vapo	f compon ur absorp	ents used in	1,7 1,7 r 1,2	1, 1
CO1 Explain working CO2 Summarize the refrigeration at the refrigeration of the refrigeration	ng of refrigeration of application of application of and air-condition performance of systems. The performance of a systems are and winter a system and winter a syst	on and air of refrigeraning system of vapour of condition	conditionin nts and wons. compression	g system orking o n, vapo s based	f compon ur absorp on cooling	ents used intion and ai	n 1,7 r 1,2	1, 1 1,2 1,2,3
CO1 Explain working CO2 Summarize the refrigeration of Evaluate the refrigeration of CO4 Design summer loads.	ng of refrigeration of application of application of and air-condition performance of systems. er and winter a	on and air of refrigera oning system of vapour of	conditionin nts and we ns. compression	g system orking o n, vapo s based	f compon ur absorp	ents used in	1,7 1,7 1,2 1,2,3	1, 1 1,2 1,2,3
CO1 Explain working CO2 Summarize the refrigeration of the refrigeration	ng of refrigeration of application of application of and air-condition performance of systems. The knowledge systems are and winter a systems are and winter a systems are as a systems are as a system are as a system are are a system are are a system are are a system are a system are are a system are a	on and air of refrigeration of vapour of vapour of condition	conditionin nts and wons. compressioning system	g system orking o n, vapo s based rking of	f compon ur absorp on cooling	ents used in tion and aignormal and heating olers and aignorpsitals are	1,7 r 1,2 g 1,2,3	1, 1 1,2 1,2,3
CO1 Explain working CO2 Summarize the refrigeration of the refrigeration	ng of refrigeration of application of and air-condition performance of systems. er and winter a the knowledge systems used i	on and air of refrigeral on and air of refrigeral of vapour of the condition of construction of construction of condition of construction of condition of conditi	conditionin nts and we ns. compression ing system uction, wo rage, autor	g system orking of n, vapo s based rking of motive v	on cooling water cooling	ents used in tion and ai and heating olers and ai nospitals and	1,7 r 1,2 g 1,2,3 r 1,2	1, 1 1,2 1,2,3
CO1 Explain working CO2 Summarize the refrigeration of the refrigeration	ng of refrigeration of application of application of and air-condition performance of systems. The knowledge systems used in	on and air of refrigerating system of vapour of condition e on construction food sto	conditionin nts and wons. compressioning system uction, wo rage, autor	g system orking o in, vapo s based rking of motive v	on cooling water cooling wehicles, h	ents used in tion and ai g and heating olers and ai nospitals and	1,7 r 1,2 g 1,2,3 r 1,2	1, 1 1,2 1,2,3 1
CO1 Explain working CO2 Summarize the refrigeration of the refrigeration	ng of refrigeration of application of application of and air-condition performance of systems. The knowledge systems used in	on and air of refrigeral on and air of refrigeral on condition of construction of condition on food sto	conditionin nts and wens. compression ing system uction, wo rage, automated and a faction of a	g system orking of on, vapo s based rking of motive v	on cooling water coolingle	ents used in the state of the s	1,7 r 1,2 g 1,2,3 r 1,2	1, 1 1,2 1,2,3 1
CO1 Explain working CO2 Summarize the refrigeration as Evaluate the refrigeration as Design summer loads. Demonstrate CO5 conditioning theaters. CO6 Discuss cryogo BLOOM'S LEVELOF T	ng of refrigeration of application of application of and air-condition performance of systems. The knowledge systems used in the knowledge systems used in the knowledge of the	on and air of refrigeration of vapour of vapour of condition of construction of construction food stoled for lique	conditionin nts and wons. compressioning system uction, wo rage, autor	g system orking of n, vapo s based rking of motive v	rs. f compon ur absorp on cooling water coo yehicles, h	ents used in tion and ai g and heating olers and ai nospitals and	1,7 r 1,2 g 1,2,3 r 1,2	1, 1 1,2 1,2,3 1
CO1 Explain working CO2 Summarize the refrigeration of the refrigeration	ng of refrigeration of application of and air-condition performance of systems. er and winter a the knowledge systems used in the knowledge of the knowledge o	on and air of refrigeral on and air of refrigeral on condition of condition on construction of food stoed for lique of treatments.	conditionin nts and we ns. compression ing system uction, wo rage, autor faction of a Blc Apply	g system orking of on, vapour s based rking of motive variand o	water coordings water coordinates water co	ents used in the state of the s	1,7 r 1,2 g 1,2,3 r 1,2	1, 1 1,2 1,2,3 1 1 Create
CO1 Explain working CO2 Summarize the refrigeration of the refrigeration	ng of refrigeration of application of application of and air-condition performance of systems. The knowledge systems used in	on and air of refrigeration of refrigeration of vapour o	conditionin nts and wons. compression ing system uction, wo rage, autor faction of a Apply (L3)	g system orking of n, vapo s based rking of motive v	water covehicles, h	ents used intion and aid and heating olers and aid nospitals and Evalua (L5)	1,7 r 1,2 g 1,2,3 r 1,2	1, 1 1,2 1,2,3 1 1 Create (L6)
CO1 Explain working CO2 Summarize the refrigeration of the refrigeration	ng of refrigeration of application of application of and air-condition performance of systems. The knowledge systems used in the knowledge systems used in the knowledge of the	on and air of refrigeral ining system of vapour of vapour of condition of construction food stoed for lique of treatment o	conditionin nts and wons. compression ing system uction, wo rage, autor faction of a Apply (L3)	g system orking of on, vapo s based rking of motive v	on cooling water coo yehicles, h xygen. vel Analyze (L4)	ents used intion and air and heating olers and air nospitals and Evaluation (L5)	1,7 r 1,2 g 1,2,3 r 1,2 1	1, 1 1,2 1,2,3 1 1 Create (L6)
Course Title Course Code Course Code Course Structure COURSE OVERVIEW This course provides thermodynamic cycle various components estimation of the carefrigeration and air work in R&AC indust COURSE OBJECTIVES 1. To understand val 2. To acquire the knowl application 5. To expose the sture work in R&AC indust COURSE OUTCOMES After the completion CO CO1 Explain working CO2 Ferigeration and course outcomes outcomes CO3 Evaluate the refrigeration and course outcomes CO4 Design summarize the refrigeration and course outcomes CO4 CO1 Explain working CO2 Ferigeration and course outcomes CO4 CO1 Explain working CO4 Design summarize the refrigeration and course outcomes CO4 CO1 Explain working CO3 Evaluate the refrigeration and course outcomes CO4 CO1 Explain working CO3 Evaluate the refrigeration and course outcomes CO4 CO1 Explain working CO3 Evaluate the refrigeration and course outcomes CO4 CO1 Explain working CO4 CO1 Explain working CO3 Evaluate the refrigeration and course CO4 CO1 Explain working CO4 CO1 Explain working CO3 Evaluate the refrigeration and course CO4 CO1 Explain working CO3 Evaluate the refrigeration and course CO4 CO1 Explain working CO4 CO1 Explain working CO3 Evaluate the refrigeration and course CO4 CO1 Explain working CO4 CO1 Explain working CO3 Evaluate the refrigeration and course CO4 CO1 Explain working CO4 Explain working CO5 CO1 Explain working CO6 CO1 Explain working CO7 Explain working CO8 Evaluate the refrigeration and course CO9 CO1 Explain working CO1 Explain working CO1 Explain working CO2 CO1 Explain working CO3 Evaluate the refrigeration and course CO4 Explain working CO5 CO1 Explain working CO6 CO1 Explain working CO7 Explain working CO8 Evaluate the refrigeration and course CO9 Explain working CO9 Exp	ng of refrigeration of application of application of and air-condition performance of systems. The knowledge systems used in the knowledge systems used in the knowledge of the	on and air of refrigeral on and air of refrigeral on refrigeral of vapour of	conditionin nts and we ns. compression ing system uction, wo rage, autor faction of a Blo Apply (L3)	g system orking of in, vapo s based rking of motive v	water coordings water coordings water coordings water coordings well Analyze (L4)	ents used interest of the second seco	1,7 r 1,2 g 1,2,3 r 1,2 1	1, 1 1,2 1,2,3 1 1 Create (L6)

			Bloom	's Level		
со	Remember	Understand	Apply	Analyze	Evaluate	Create
	(L1)	(L2)	(L3)	(L4)	(L5)	(L6)
CO1		✓				

CO2	√			
CO3		✓		
CO4			✓	
CO5		✓		
CO6	✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	P06	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	EOS4
CO1	2												3		
CO2	2						1						2		
CO3	3	2											3	1	
CO4	3	3	1										3	1	1
CO5	2	2					\wedge						3		
CO6	2					/							2		
Average	2.3	2.33	1				1						2.6	1	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Refrigeration Cycles: Methods of refrigeration, Vapour compression refrigeration cycle and actual vapour compression cycle, Air refrigeration cycle, Aircraft refrigeration system- simple and boot strap system with performance analysis. Vapour absorption systems-COP of the system, simple Ammonia-water vapour absorption system with performance evaluation-actual vapour absorption system, Lithium bromide, three fluid vapour absorption systems, and simple numerical.

Unit-2

Refrigerants: Refrigerant classification, Designation, Refrigerant properties, Oil Compatibility – Environmental Impact- ozone layer depletion, global warming, Alternate refrigerants, Refrigerant absorbent combinations for vapor absorption system.

Refrigeration Components: Reciprocating Open & Hermetic type, Screw Compressors and Scroll Compressors, Condensers-types, Evaporators-types, chillers-types, Expansion devices-capillary tube- automatic expansion valve-thermostatic expansion valve- Low side-high side float, low pressure and high pressure cut outs, solenoid valves.

Unit-3

Design of Air conditioning systems: Review of Moist air properties-various psychrometric process, Summer and Winter Air-conditioning, Cooling load calculations-comfort chart-SHF-GRSHF-ERSHF, cooling load estimate, Cooling load calculation using HVAC Design software

Unit-4

Air-conditioning Systems: Different Air-Conditioning Systems-Central – Station Air-Conditioning System, Unitary Air-Conditioning System, Window Air-Conditioner and Packaged Air-Conditioner, Air handling system- ducts and its arrangements, room air distribution- supply air outlets.

Application of Refrigeration and Air conditioning: Food storage, Domestic refrigerator-construction- working and maintenance, Cold storage plants, Water coolers-storage type and pressure type, Dessert cooler, Air conditioning systems for automobiles-car-bus-truck container, Air conditioning system in hospital, Air conditioning system in theaters, Introduction to cryogenics-liquefaction of air and oxygen.

CASE STUDIES

- ${\bf 1.}\, Cooling\, Load\, calculation\, of\, the\, residential\, house\, using\, HVAC\, software.$
- Study of Air conditioning system installed in hospital.
- 3. Study of Air conditioning system installed in theaters/auditorium.

TEXT BOOKS

1. R S Khurmi and J K Gupta, "A Text Book on "Refrigeration and Air conditioning", S Chand Publication., New Delhi, 1st Edition, 2019.

2. W.F.Stocker and J.W.Jones "Refrigeration & Air Conditioning", 2nd Edition, McGraw Hill Book Company, 1st Edition, 2014.

REFERENCE BOOKS

- 1 Manohar Prasad, "Refrigeration and Air conditioning", 3rd Edition New Age International (P) Ltd, New Delhi,1st Edition, 2021
- 2. Ananthanarayanan.P.N, "Basic Refrigeration and Air Conditioning", Tata McGraw Hill, 4th Edition, 2013
- 3. Roy J. Dossat,"Principles of Refrigeration", Pearson Education Asia, 5th Edition, 2001
- 4. Arora, C. P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 4th Edition, 2021

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/journal/international-journal-of-refrigeration
- 2. https://www.journals.elsevier.com/international-journal-of-refrigeration

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/112105129
- 2. https://nptel.ac.in/courses/112105128

Course Title	Airc	raft Fundam	entals /		Cour	se Type	Soft	Core	
Course Code	B20ERS624	Credits		3 /	C	lass	VI semester		
	TLP	Credits	Contact Hours	Work Load	\	umber of asses		sment in	
Course	Theory	3	3	3	Per Se	emester	Weightage		
Structure	Practice	0	0	0	Theory	Practical	IA	SEE	
	Tutorial	0	0	0	THEOLY	Fractical	IA	JLL	
	Total	3	3 /	3	39	0	50 %	50 %	

COURSE OVERVIEW

This course introduces the historical evaluation of Aircraft with various configurations of aircraft, propulsion systems, and their performance analysis. The course discusses the operating principles of the aircraft engine major components. The course discusses the Aircraft Structures, materials with their instruments and principles of navigation schemes.

COURSE OBJECTIVES

- 1. To provide the basic knowledge on Aircraft fundamentals, early development of airplanes (space vehicles, advance propulsion and their applications)
- 2. To enhance the knowledge on configuration of Aircrafts (Anatomy of flight vehicles, components of an airplanes and their function lift generation, significance of L/D ratio, aerodynamic forces, pressure)
- 3. To enhance the Knowledge on essential features of propulsion with their aircraft structures and their materials
- 4. To gain the knowledge of sensing devices, data acquisition, measurements in aerodynamics, flight control and principles of navigation with atmospheric entry missions

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes	POs	PSOs
CO1	Acquire the knowledge on history of aircrafts and developments.	1	1
CO2	Recognize the classifications of aircraft components and their configurations.	1	1
10.03	Apply the basic concepts of propulsion systems for the study of spacecraft and aircraft performance	1	1
CO4	Interpret the different types of fuselage and their constructions.	1	1
CO5	Gain the knowledge of the different types of aircraft materials.	1	1
CO6	Analyze the different types of navigation systems and instruments for flight.	1, 2	1, 2

BLOOM'S LEVELOF THECOURSE OUTCOMES

со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	✓					
CO2		✓				
CO3			✓			
CO4			✓			
CO5			✓			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	P01	P02	P03	P04	PO5	P06	P07	P08	P09	PO10	PO11	PO12	PSO1	PS02	PS03
CO1	2												3		
CO2	2						\wedge						3		
CO3	3					/							3		
CO4	2												3		
CO5	2				/								3		
CO6	3	2											3	2	
Average	2.3	2		/	/								3	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Aircraft Fundamentals: History of aviation, early development of airplanes, biplanes and monoplanes, history of spaceflight, development of space vehicle, International standard atmosphere, classification of duct jet propulsion, rocket propulsion, advance propulsion and applications.

Unit-2

Configurations of Aircraft: Anatomy of flight vehicles, components of an airplanes and their functions, configuration of space vehicle, Importance of aerodynamics; Airfoils and streamlines; Forces acting on an airplane - lift and drag, types of drag; Factors affecting lift and drag; Types of flow and their governing equations; Speed and power. Straight and level flight; Conditions for minimum drag and minimum power; Gliding, cruise and climbing flight; Range and endurance; Takeoff and landing; V-n diagram.

Unit-3

Aircraft Propulsion: Classification and essential features of propulsion, jet propulsion, general characteristics of rocket engines, theory of propulsion, elementary gas dynamics, spacecraft and aircraft performance

Aircraft Structures and Materials: General types of construction and structural layout, monocoque, semi monocoque, corrugated, sandwich structure, reinforced and honeycomb structures, geodesic construction, aerospace materials, metallic and nonmetallic materials, use of aluminum alloy, titanium, stainless steel, composite and ceramic materials.

Unit-4

Aircraft Instruments and Navigation: Instrument displays; Introduction to navigation instruments; Basic air data systems and probes- Mach meter, air speed indicator, vertical speed indicator, Altimeter, gyro based instruments. Measurements in aerodynamics, flight structures, and flight control, principles of navigation, celestial, radio, and inertial navigation schemes, navigational and guidance requirements for orbital, planetary, and atmospheric entry missions.

CASE STUDIES

- 1. Conceptual Aero-Design Analysis
- 2. Case Study on Investigation of Aero foil for Flapping Wing Aircraft
- 3. Fundamentals of Aircraft and Airship Design
- 4. Increasing the Efficiency of Aircraft Ground Handling—A Case

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5. Case Study: REVA	Transports with	a Technolog	gy Edge.					
6. Aircraft Conceptu	al Design Practio	es & Case St	tudies.					
TEXT BOOKS								
1 Merrill, G., "Princi	ple of Guided M	ssile Design	", Literary	Licensin	ig, LLC, 1st	Edition, 201	l1.	
3 Pallet. E.H.J "Airo	raft Instruments	& Principle	s". Pitmar	n Publish	ing: 2 nd Ed	ition. 1981.		
4. Mattingly J.D., "E	lements of Propi	ulsion: Gas T	urbines a	nd Rocke	et", AIAA, 2	2 nd Edition, 2	2017.	
5.Leland M. Nicolai	and Grant E. Ca	arichner, Fu	ndamenta	ıls of Air	craft and	Airship Desi	gn Volume	e I – Aircraft
Design, AIAA Edu	cation Series, 20	10						
1 Kermode, A.C., "Fl	: ight without For	mulae". Pea	rson India	a. 5 th Edit	tion, 2004.			
2 Lalit Gupta and O	P Sharma, "Func	lamentals of	Flight Vo	l-I to Vol	-IV", Hima	layan Books	, 2006	
3 Anderson, J. D., "I	ntroduction to F	ight", McGr	aw-Hill, 8 ^t	h Edition	, 2015.			
4. Cohen, H.Rogers,	G.F.C. and Sara	vanamuttoc), H.I.H. "(Gas Turb	ine Theor	/", Pearson	Education,	7th Edition,
IOURNAI S/MAGA7I	NFS							
1. http://airspot.ru/	book/file/73/hu	ll airplane [.]	flight med	chanics.r	odf			
2. https://fas.org/iri	o/doddir/armv/f	m3-04-203.i	pdf	/	•			
3. http://ae.sharif.e	du/~iae/Downlo	ad/Introduc	tion%20to	o%20flig	ht.pdf			
4. http://www-pw.p	hysics.uiowa.ed	u/~dag/lect	ures/Fligh	t_Dec12	-2003.pdf			
5. https://www.free	engineeringboo	ks.com/Aero	Space/Ai	rcraft-St	ructures-B	ooks.php		
6. https://docs.goog	gle.com/file/d/01	3w8Mfqmg\	WLS4RINq	aE1oUzd	lOajQ/viev	?pref=2&pl	i=1	
7. https://www.scri	od.com/docume	nt/6358827	0/Aerospa	ace-Prop	ulsion-Sys	tems		
8. https://www.crcp	ress.com/Aircra	ft-Propulsio	n-and-Gas	s-Turbine	e-Engines/	ElSayed/p/b	ook/97808	349391965
SWAYAM/NPTEL/N	100Cs:							
1. nttps://www.edu	cpa.com/course	elements-c	η-aeronau	itics/	20 6==			
2. https://www.ude	org/course/inte	e-engineerir	ig-trom-ze	ero-to-1(υυ-τοr-evel	yone/		
4 https://www.edx	.org/course/intr	Juuction-to- Jelements o	-aeronar nf-aeronar	itics/	neering			
Course Title	Inde	ustrial Engin	eering	1005/	Cours	e Type	Soft	Core
Course Code	B20ERS625	Credits		3	CI	ass	VI sei	mester
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Course Structure	Theory Practice	0	0	0	Theory	Practical	IA	SEE
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Course Structure COURSE OVERVIEW Industrial engineeri implementation of ito optimize the cor	Theory Practice Tutorial Total ng is an engine ntegrated system plex engineering is closely as	0 0 3 ering profes ms of knowl	0 0 3 ssion whice edge, info	0 0 3 ch deals ormation ms and	Theory 39 with the , equipme organization gineering	development, human rons, dealing	50 % nt, improve esources, a in engineer and to week	SEE 50 % ement and and finance ering work.
Course Structure COURSE OVERVIEW Industrial engineeri implementation of i to optimize the cor Industrial engineeri	Theory Practice Tutorial Total ng is an engine ntegrated system nplex engineering is closely as	0 0 3 ering profes ms of knowling processes sociated with the profession by de-	0 0 3 ssion whice edge, info	0 0 3 ch deals ormation ms and oction en	Theory 39 with the , equipme organization gineering	development, human roons, dealing which interportation are	50 % nt, improve esources, a in engineer inds to work	SEE 50 % ement and and finance ering work. rk towards
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5. Case Study: REVA 6. Aircraft Concepture TEXT BOOKS 1 Merrill, G., "Princi 2 Richard S. Shevell, 3 Pallet, E.H.J., "Airco 4. Mattingly J.D., "E 5. Leland M. Nicolai Design, AIAA Edure REFERENCE BOOKS 1 Kermode, A.C., "Fl 2 Lalit Gupta and O 3 Anderson, J. D., "In 4. Cohen, H.Rogers, 2019. JOURNALS/MAGAZI 1. http://airspot.ru/ 2. https://fas.org/irj 3. http://ae.sharif.e 4. http://www.pw.p 5. https://www.free 6. https://docs.goog 7. https://www.scril 8. https://www.crcp SWAYAM/NPTEL/N 1. https://www.edu 2. https://www.edu 2. https://www.edu 4. https://www.edu Course Title Course Code Course Code Course Code Course Title Course Code	Theory Practice Tutorial Total Ing is an engine integrated system in the processes in the maxingle specialization is related to open in the processes in the maxingle specialization is related to open in the processes in the maxingle specialization is related to open in the processes in the maxingle specialization is related to open in the processes in the processes in the maxingle specialization is related to open in the processes in the processes in the maxingle specialization is related to open in the processes in the processes in the processes in the maxingle specialization is related to open in the processes in the process	o o o o o o a ering profes ms of knowl ng processes sociated wi uction by de anufacture of cion with insectional analog orational analog of principles of the design	o o o o o o o o o o o o o o o o o o o	0 0 3 ch deals armation ms and action en delopmen act. Industrem grade work streasuring system deals and work en decentration of the control	with the pequipment of the control o	development, human rons, dealing which interentation, opercoduction end industrial designing the roductivity in the roductivity	IA 50 % Int, improve esources, a in engineering eration, mangineering all engineering erations where the work system proveme	SEE 50 % ement and and finance ering work. rk towards aintenance, course are ing degree. eems. rk.

5. To provid	e a de	etailed	under:	standin	g of wo	rk stu	dy and	worki	ng envi	ronmer	nt.				
industrie	de an s.	adequ	iate b	ackgro	und for	apply	ing th	e con	cept of	work	study	and wo	ork en	vironr	nent i
COURSE OL	TCON	ΛES (CC	Os)												
After the co	mplet	ion of	the co	urse, th	ne stude	ent wil	ll be ab	le to:							
со					Cours	e Out	comes						POs	F	PSOs
CO1 Discu	ss the	indust ent in c	trial er organiz	ngineer ations.	ing prin	ciples	that in	fluenc	e the p	roducti	vity		1	-	1,2,3
CO2 Applywork	the r syste	method ms.	ls of e	ngineer	ing and	opera	ational	analys	is in re	-design	ing of		1,2	-	1,2,3
CO3 Apple	engi	neering	work	measu	rement	princ	iples in	analy	zing an	d meas	ureme	nt of	1,2	=	1,2,3
CO4 Analy	ze th	e work	proce	sses us	ing adva	anced	work s	tudy t	ools an	d techn	iques.		1,2,5		1,2,3
CO5 Dem	onstra ning v	nte an u work sy	ınders stems	tanding	g of eme	erging	conce	ots and	d applic	ations	n		1,2,3		1,2,3
CO6 Evalu	ate w	ork stu	dy an	d worki	ng envi	ronme	ent tow	ards i	mprovii	ng prod	uctivit	У	1,2		1,2,3
BLOOM'S L	VELO	F THEC	COURS	E OUT	OMES			0000/-	Lovel						
со	R	ememl	oer	Unde	rstand	· /	Apply	JOIN S	Anal	vze	F۱	/aluate		Crea	ate
	rovide a detailed understanding of work study and working environment. rovide an adequate background for applying the concept of work study and work environment in stries. E OUTCOMES (COS) The completion of the course, the student will be able to: Course Outcomes Course Outcomes Course Outcomes POS PSOS Discuss the industrial engineering principles that influence the productivity provided in organizations. Apply the methods of engineering and operational analysis in re-designing of understands. Apply the methods of engineering and operational analysis in re-designing of understands. Apply the methods of engineering and operational analysis in re-designing of understands. Apply the methods of engineering and operational analysis in re-designing of understands. Apply the methods of engineering and operational analysis in re-designing of understand understanding of emerging concepts and applications in 1,2,3 1,2														
CO1				\ ,	/ \		\								
CO2)2														
CO3)3														
CO4				/						<u> </u>		/			
CO5			, Y	/_			√ √ '			/ \	, v	/_			
CO6									$\overline{}$,					
COURSE AR	TICUL	ATION	MATR	IX T				\rightarrow							
CO/ POs	ر P01	. P02	P03	P04	POS	P06	P07	P08	P09	PO10	P011	P012	PSO1	J PS02	PSO3
CO2	3	2											2	2	
CO3	2	1				\			\/				2	2	
CO4	2	1			1	<			†				2	2	
CO5	2	2	1										2	2	
CO6	3	2											2	2	
Average Note: 1-Lov	2 , 2-M	1.7 edium,	1 , 3-Hig	h	1								2	2	
COURSE CO	NTEN	т	-												
						ı	Jnit-1								
Introductio	n: Sco	pe of	Indust	rial Eng	gineerin	g, Evo	olution	of Inc	ustrial	Engine	ering a	approad	ch. Nat	ture o	f work
concents N	rk sy:	stems,	Work	systen ms \//a	ns as a	tield aching	ot pro	TESSÍO ms Ai	nal pra	ctice, T	ype o k sveti	T UCCU	pation,	Prod	uctivit
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Methods E Approach ir	n gine o n Met	ering a hods E	nd O p	peratio ering, T	ns Anal echniqu	ysis : ues of	Evoluti Metho	en an ods En	d Scope gineeri	e of Mo	ethods ecting	Engin Alterna	eering, itive In	Syste	ematic ement
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			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		\				
CO2				\		
CO3			V/4 /			>
CO4				(/ / / /	\wedge / /	
CO5			\\ \ \			
CO6				\ \ \		

CO/ POs	PO1	P02	PO3	P04	PO5	90a	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PSO2	EOS4
CO1	2	2							/				2	2	
CO2	3	2					\wedge						2	2	
CO3	2	1											2	2	
CO4	2	1			1	<							2	2	
CO5	2	2	1										2	2	
CO6	3	2											2	2	
Average	2	1.7	1		1								2	2	

Proposals, Basic Data Collection and Analysis Techniques, Methods Engineering and Automation.

Charting and Diagramming Techniques for Operations Analysis: Overview of the techniques, Network diagrams, Traditional Charting and Diagramming techniques, Block diagrams and Process maps.

Motor Study and Work Design: Basic motion elements and Work analysis. Principles of motion coronny and work Design, Case Studies.

Unit-3

Introduction to Work Measurement: Determination of Time Standards – Methods, Work Measurement Techniques, Prerequisites for valid time standards, Allowances in Time Standards, Accuracy and Precision, Application of Speed Ratio.

Direct Time Study Procedure, Determination of Number of Work Cycle to be Timed, Performance Rating, Time Study Equipment, Numerical.

Predetermined Motion Time Systems: Over view, Methods – Time Measurements, Maynard Operations Sequence Technique.

Unit-4

Standard Data Systems: Standard Data Systems: Over view, Methods – Time Measurements, Maynard Operations Sequence Technique.

Unit-4

Standard Data Systems: Standard Data Systems: Over view, Methods – Time Measurements, Maynard Operations Sequence Technique.

Unit-4

Standard Data Systems: Standard Data Systems overview, steps, elements classifications. Work Sampling: Statistical Rasis of work sampling, Application issues in work sampling (Including numerical).

Learning Curves. Determining the Learning Rive, Factors effecting the Learning Curve. Applications, Time Standards Vock Sampling, Curve.

Computerized Work Measurement and Standards Maintenance: Computer Systems for Direct Time Study and Work Sampling, Computerized Systems Based on Report Systems, Maintenance of Time Standards.

CASE STUDIES

1. Reducing Labor Cost using industrial Engineering technique.

2. Work Measurement approach for productivity improvement in shop floor.

3. Enhancing of productivity for manual and automated assembly line.

4. Improvements in material handling "a case study of cement manufacturing plant".

TEXT BOOKS

1. Misliel Procure:

Course Title	En	ergy Techno	logy		Cour	е Туре	Open	Elective
Course Code	B20MEO601	Credits	3	3	С	lass	VI Se	mester
	TLP	Credits	Contact	Work	Total N	umber of	Vecoci	sment in
	ILF	Credits	Hours	Load	Cla	isses		ghtage
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Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

SWAYAM/NPTEL/M0 1. https://onlinecour	OOCs: rses.nptel.ac.in	/noc22_me0)4/preview	ı	ı	·		
Course Title	E	nergy Techn	ology		Cours	ве Туре	Open I	Elective
Course Code	B20MEO601	Credits		3 	C	ass	VI Ser	nester
_	TLP	Credits	Hours	Load	Total N	umber of isses	Assess Weig	ment in htage
Course	Theory	3	3	3	Per Se	emester		
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tatal	2	0	0	20	0	FO 0/	FO 0/
COURSE OVERVIEW	iotai	3	3	3	39	U	5U %	50 %
SWAYAM/NPTEL/Me 1. https://onlinecour Course Title Course Code Course Structure COURSE OVERVIEW This course explores used for steam geneenergy and its charact gaseous forms. Furth etc. COURSE OBJECTIVES 1. To understand ene 2. To gain the knowle 3. To enhance the kn 4. To enable the stud COURSE OUTCOMES After the completion CO CO1 Summarize the handling syste CO2 Identify renew CO3 Discuss the prand biogas ene CO4 Describe the recomparison w CO6 Investigate the BLOOM'S LEVELOF T CO Remo (II CO1 CO2 CO3 CO4 CO5 CO6	ergy scenario, eedge about die owledge about die owledge about dents to gain the (COs) of the course, ee basic conceptems used in stervable energy refinciples of energy systems, methods used to main characteristic fossil fuels. ee design parameters	energy sourcesel engine potent renewable e knowledge the student Course Course of the sources and ergy conversion generate betteristics of the student are power potentials.	es and the ower plant energy so e on hydro will be ab Outcomes I energy sy lants. I their utilition of win renewab	eir utiliza t. urces. urces. ugen ene le to: ustems an zation. d, geoth energy. le energy. ers.	rgy general nd identify ermal, occurrent	coal and ash	POs 1 1,6,7 1,6,7 1,7 1,6,7 1,2,3,7	PSOs 1 1 1,2 1 1,2,3
BLOOM'S LEVELOF T	HECOURSE OU	TCOMES					1	
			Ble	oom's Le	evel			
CO Remo	ember Und	derstand	Apply		Analyze	Evalua	ite	Create
(1	L1)	(L2)	(L3)		(L4)	(L5)		(L6)
CO1		√ 						
CO2		٧	1					
CO3			√					
CO4		٧						
CO5		٧			,			
CO6					√			
<u> </u>					v			

			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2		√				
CO3			$\sqrt{}$			
CO4		V				
CO5		V				
CO6				√		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	P02	PO3	P04	PO5	P06	PO7	P08	P09	PO10	PO11	PO12	PSO1	PSO2	PS03
CO1	3												3		
CO2	3					2	2						3		
CO3	3	2				2	2						3	2	
CO4	3						1						3		
CO5	3					2	1						3		
CO6	3	2	1										3	1	1
Average	3	2	1			2	1.5						3	1.5	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Thermal Energy Conversion System: Review of energy scenario in India, General Philosophy and need of Energy, Different Types of Fuels used for steam generation, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace,

Coal and Ash Handling: Chimneys: Natural, forced, induced and balanced draft, Cooling towers and Ponds

Unit-2

Diesel Engine Power System: Applications of Diesel Engines in Power field. Method of starting Diesel engines. Auxiliaries like cooling and lubrication system, filters, centrifuges, Oil heaters, intake and exhaust system, Layout of diesel power plant.

Solar Energy and Applications: Solar radiation - Availability- Measurement and estimation- Solar radiation geometry

Hydrogen Energy: Introduction to hydrogen energy, methods of hydrogen production (electrolytic and thermo chemical method).

Unit-3

Wind Energy: Wind energy - General considerations - Wind Power plant design – Horizontal axis wind turbine **Tidal Power:** Power generation using OTEC - Wave and Tidal energy - Scope and economics - Limitations.

Hydro-Electric Energy: General layout of hydel power plants, Hydrographs, flow duration and mass curves and numerical. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves.

Unit-4

Biomass Energy Sources: Biomass production for energy farming, origin of Biomass-Photosynthesis process, Energy through fermentation -Ethanol Production from sugarcane and starch, Biomass characteristics.

Bio-Methanization: Anaerobic digestion, Basic principles, factors affecting biogas yield, biogas digester (floating gas holder and fixed dome type with working principle and diagram).

Geothermal Energy Conversion: Availability - Geographical distribution.

TEXT BOOKS

- 1. P.K Nag, "Power Plant Engineering", 3rd Ed. Tata McGraw Hill, 2nd edition 2001.
- 2. Morse F.T, Van Nstrand, "Power Plant Engineering", 1998.
- 3. B H Khan, "Non-conventional energy resources", McGraw Hill Education, 3rd Edition, 2017.
- 4. A. W. Culp Jr, "Principles of Energy conversion", McGraw Hill. 1996

REFERENCE BOOKS

- 1. Stanier, "Plant Engg. Hand Book, McGraw Hill, 1998.
- 2. Domakundawar, "Power Plant Engineering", Dhanpath Raisons, 2003
- 3. S.P. Sukhatme, "Solar Energy: principles of Thermal Collection and Storage", Tata McGraw-Hill, 1984.
- 4. L.L. Freris, "Wind Energy Conversion Systems", Prentice Hall, 1990.

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/topics/engineering/ash-handling-plant
- 2.https://www.researchgate.net/publication/267838546_Survey_of_modern_power_plants_driven_by_diesel __and_gas_engines.

- 3. https://www.journals.elsevier.com/international-journal-of-hydrogen-energy
- 4. https://www.sciencedirect.com/science/article/pii/S2211467X19300379

SWAYAM/NPTEL/MOOCs:

- 1. https://onlinecourses.nptel.ac.in/noc21 me86/preview
- 2. https://nptel.ac.in/courses/103107157
- 3. https://onlinecourses.nptel.ac.in/noc21_ch11/preview
- 4. https://onlinecourses.nptel.ac.in/noc22_ch27/preview

Course Title	Н	eat Transfer	Lab		Cours	se Type	Hard	d Core
Course Code	B20ER0604	Credits		L	С	lass	VI Se	mester
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in
Course	Theory	0 /	0	0 ^	Per Se	emester	wei	ghtage
Structure	Practice	1	2	<u>/2</u>	Theory	Practical	IA	SEE
	Tutorial	0 ^	0	0 \	Theory	riactical	IA	SÉE
	Total	1	/2 /	2	0	26	50 %	50 %

COURSE OVERVIEW

Heat Transfer laboratory provides fundamental and industrial knowledge about modes of heat transfer, like conduction, convection and radiation, and their application. Concepts of heat transfer are applied in the field of Heat Exchanger design and phase change phenomenon. This course deals with the concepts of thermal conductivity, convective heat transfer coefficient, Stephen Boltzmann constant, transient heat transfer, vapor compression refrigeration and Air conditioning systems.

COURSE OBJECTIVES

- 1. Provide knowledge on modes of heat transfer and laws governing the Heat and Mass transfer.
- 2. Analyze various techniques to compute the heat transfer coefficient in various heat transfer problems.
- 3. Conduct experiment to study variation of temperature along the length of the pin fin under forced and free Convection.

- 4. Carryout analysis of boiling and condensation phenomenon and design heat transfer equipment.
- 5. Conduct experiments related to various heat transfer processes and heat exchangers and analyze measurements data.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO	Course Outcomes	POs	PSOs
CO1	Describe the three modes of heat transfer and their governing equations.	1	1,2
CO2	Perform conduction heat transfer experiment to estimate thermal conductivity of metal rod, overall heat transfer coefficient of composite slab and document the results in the form of technical report		1,2
CO3	Evaluate the heat transfer coefficients in forced convection, free convection and Correlate with theoretical values and document the results in the form of technical report.	1,2,4, 9,10	1,2
CO4	Perform experiments on radiation heat transfer to determine surface emissivity and Stefan-Boltzmann's constant and document the results in the form of technical report.	1,2,4,9, 10	1,2
CO5	Evaluate heat transfer coefficients in condensation, boiling, LMTD and effectiveness of heat exchangers and document the results in the form of technical report.	1,2,4,9, 10	1,2
CO6	Conduct experiments, interpret the data, analyse Vapour compression refrigeration, Air conditioning system and document the results in the form of technical report.	1,2,4,9, 10	1,2

			Bloom	's Level		
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2			✓			
CO3			✓			
CO4			✓			
CO5			✓			
CO6				✓		

Shoom's Level Co Remember Understand Apply Analyze Evaluate Create (LS) (BLOOM'S L	EVELO	F THE	ECOU	RSE (оитсо	MES										
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CO3 CO4 CO5 CO5 CO6 CO5 CO6 CO5 CO6 CO5 CO6	CO2								✓								
COURSE ARTICULATIONMATRIX CO/ POS	CO3								✓								
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Note: 1-Low, 2-Medium, 3-High List of Experiments 1. Determination of thermal conductivity of a metal rod. 2. Determination of overall heat transfer coefficient of composite slab. 3. Analysis of heat transfer through pin-fin. 4. Experiment on transient conduction heat transfer. 5. Estimation of heat transfer coefficient for natural convection heat transfer. 6. Estimation of heat transfer coefficient for forced convection heat transfer. 7. Determination of emissivity of a surface 8. Determination of EMDT and effectiveness in a parallel flow and counter flow heat exchangers. 10. Experiment on boiling of liquid and condensation of vapour. 11. Performance test on vapour compression refrigeration. 12. Performance test on a vapour compression air – conditioner TEXT BOOKS 1. Tirumaleshwar, "Heat & Mass transfer", Pearson Education, 2014. 2. Ozisik, Heat transfer-A basic approach, Tata McGraw Hill, 1985. REFERENCE BOOKS 1. Yunus A-Cengel, "Heat transfer-A practical approach", Tata McGraw Hill, 2 nd Edition, 2002. 2. Mahesh M Rathore, "Heat and mass transfer", Laxmi publications, 2017. 3. Frank Kreith, Raj. M. Manglik, Mark. S. Bohn, "Principles of Heat transfer", Thomas Learning, 7 th Edition, 2010. 4. Frenk P. Incropera and DavidP. Dewitt, "Fundamentals of heat and mass transfer", John Wiley and son's, 5 th Edition, 2007. 5. R K Rajput, "Heat and Mass transfer", S Chand Publications, 2018. JOURNALS/MAGAZINES 1. The Journal of Heat Transfer, ASME 2. International Journal of Heat and Mass Transfer, Elsevier SWAYAM/NPTEL/MOOCs:	CO6	3	3	-		1/	/			\wedge	3	3			1	1	1
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Course Title	Computer Aid	ed Engineer	ing Analy	sis Lab	Cours	se Type	Hard	d Core
Course Code	B20ER0605	Credits	1	1	С	lass	VI Se	mester
	TLP	Credits	Contact	Work	Total N	umber of	٨٥٥٥٥	mont in
	ILP	Credits	Hours	Load	Cla	isses		sment in
Course	Theory	0	0	0	Per Se	emester	wei	ghtage
Structure	Practice	1	2	2	Thoom	Dractical	1.0	CEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
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Course Title	Computer Aid	ded Enginee	ering Analy	sis Lab	Cours	е Туре	Har	d Core
Course Code	B20ER0605	Credits	Contact	L Work	Total N	ass umbor of	VI Se	emester
	TLP	Credits	Hours	Load	Cla	sses	Asses	sment in
Course	Theory	0	0	0	Per Se	mester	Wei	ightage
Structure	Practice	1	2	2	Theorem	Dractical	1.0	CEE
	Tutorial	0	0	0	ineory	Practical	IA	SEE
	Total	1	2	2	0	26	50 %	50 %
Course Title Course Code Course Structure COURSE OVERVIEW This course deals with standard mathematic involved in FEM, Selection world engineering procourse objectives 1. To acquire basic uplaced to acquire basic uplaced parameter and the related para	rs of bars, bean he basic princip (COs) of the course,	ns and truss les to carry the student	loaded wir	th loading al and dy	g conditio	ns alysis	POs	PSOs
CO1 Define and Un	derstand the st	teps involve	d in FEM,	and vario	ous comm	ands used	1 2	1 303
in ANSYS simul	lation software						1,2	1
CO2 Formulate finit	te elements like	e the bar, tr	uss, and be	am for I	inear stati	c structural	1,2,3,5,9	,12 1,2,3
CO3 Determine the	Stress analysis	of a rectan	gular plate	with a c	ircular hol	e	<u>1,2,</u> 3,5,9	,12 1,2,3
i L	the deflection	of beams su	ubjected to available re	point, esults to	uniformly draw shea	distributed r force and	1,2,3,5,9	,12 1,2,3
Demonstrate to CO4 and varying load bending more	ads and further					l.		
Demonstrate t CO4 and varying loa bending mome	ads and further ent diagrams amic analysis a	nd finding n	atural freq	uencies	for variou	s boundary	1,2.3.5.9	.12 1.2.3
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CO5 CO6 Develop finite the results in t	ads and further ent diagrams amic analysis and also analyse wellement equating form of techiber OURSE OURSE OU	nd finding n with forcing f ons for 1D a nnical report TCOMES	atural frequencial frequency and 2D head to the second sec	uencies transfer	for variou	s boundary and record	1,2,3,5,9 1,2,3,5,9,1	,12 1,2,3
CO5 CO6 CO6 CO7	ads and further ent diagrams amic analysis and also analyse welement equati he form of tech HECOURSE OU	nd finding n vith forcing f ons for 1D a nnical report	atural frequencial frequency and 2D heart.	uencies transfer	for variou	s boundary and record	1,2,3,5,9,1	,12 1,2,3 .0,12 1,2,3
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CO4 CO2 CO3 CO4 CO5 CO6 CO6 CO6 CO7 CO6 CO7	ads and further ent diagrams amic analysis and also analyse wellement equation the form of tech ember Uncertainty	nd finding n with forcing f ons for 1D a nnical report TCOMES derstand (L2)	atural frequenction and 2D hear t. Bloom (L3)	transfer	relements vel Analyze (L4)	Evalu (L5	1,2,3,5,9,1 1,2,3,5,9,1 ate	,12 1,2,3 .0,12 1,2,3 Create (L6)
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CO4 and varying load bending mome conditions and conditions and the results in the results in the results in the results in the conditions and conditions and the results in the results in the conditions and conditions and the results in the results in the results in the results in the conditions and conditions and the results in the conditions and conditions and conditions and conditions and conditions are conditions and conditions and conditions and conditions are conditions and conditions are conditions and conditions are conditions and conditions are conditions and conditions and conditions and conditions are conditions.	ads and further ent diagrams amic analysis and also analyse wellement equation the form of tech (HECOURSE OU) ember Uncertain Uncertain (HECOURSE OU)	nd finding n vith forcing f ons for 1D a nnical report TCOMES	atural frequenction and 2D hear t. Bloom (L3)	uencies transfer	vel Analyze (L4)	Evalu (L5	1,2,3,5,9,1 1,2,3,5,9,1 ate	7,12 1,2,3 1,2,3 1,2,3 Create (L6)
CO4 CO5 CO1 CO5 CO6 CO6 CO7 CO6 CO7	ads and further ent diagrams amic analysis and also analyse wellement equation the form of techt (HECOURSE OUT) Ember Uncertainty IONMATRIX	nd finding n vith forcing f ons for 1D a nnical report TCOMES derstand (L2)	atural frequenction and 2D heads. Bloom Apply (L3)	uencies transfer	relements vel Analyze (L4)	Evalu (L5	1,2,3,5,9,1 1,2,3,5,9,1 ate)	7,12 1,2,3 1
CO4 CO5 CO6 CO1 CO6 CO7 CO6 CO7	ads and further ent diagrams amic analysis and also analyse wellement equation the form of tech (HECOURSE OUT) ONMATRIX	nd finding n with forcing f ons for 1D a nnical report TCOMES derstand (L2)	atural frequenction and 2D heads. Blood Apply (L3)	uencies transfer	relements vel Analyze (L4)	Evalu (L5	1,2,3,5,9,1 1,2,3,5,9,1 ate) 0 2 3 2	72 1,2,3 1,2,3 1,2,3 1,2,3 Create (L6)
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	Bloom's Level									
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)				
CO1		✓								
CO2				✓						
CO3			✓							
CO4				√						
CO5			✓							
CO6			√							

CO/ POs	PO1	50d	ЕОЗ	PO4	50d	90d	20d	80d	60d	PO10	PO11	PO12	PSO1	ZOS4	PS03
CO1	2												2	1	1
CO2	2	3	2		3				3			3	2	1	1

Average	2	2.8	1.8	3		3		3	2	1	1
CO6	2	3	2	3		3		3	2	1	1
CO5	2	3	2	3		3		3	2	1	1
CO4	2	3	2	3		3		3	2	1	1
CO3	2	2	1	3		3		3	2	1	1

Note: 1-Low, 2-Medium, 3-High

Part-A

Study of an FEA package and modeling, stress analysis of

- 1. Bars of uniform cross-section area, tapered cross-section area, and stepped bar
- 2. Trusses (Minimum 2 exercises).
- 3. Beams Simply supported, cantilever, beams with UDL, beams with varying load, etc

Part-B

- 1. Stress analysis of a rectangular plate with a circular hole
- 2. Thermal Analysis 1D & 2D problem with conduction and convection boundary Conditions
- 3. Dynamic Analysis of Fixed fixed beam for natural frequency determination subjected to forcing function

TEXT BOOKS

- 1. S.S.Bhavikatti, "Finite Element Analysis", New Age International publishers, 2006
- 2. Tripathi. R .Chandrapatla, Ashok.D.Belegundu, "Finite Elements in Engineering", 3rdEdition, PHI Publishers, New Delhi

REFERENCE BOOKS

- 1. Daryl. L. Logon, "Finite Element Methods", Thomson Learning 3rdedition, 2001
- 2. J.N.Reddy, "Finite Element Method", Mc Graw Hill International Edition

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/journal/finite-elements-in-analysis-and-design
- 2. https://www.hindawi.com/journals/mpe/si/632341/

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/112104116
- https://onlinecourses.nptel.ac.in/noc20_me91/preview

Course Title	Techn	ical Docum	entation	Cours	е Туре	FC			
Course Code	B20ER0606 Credits 1		CI	ass	VI semester				
	TLP	Credits	Contact Hours	Work Load	Total Number of Classes		Assessment in Weightage		
Course	Theory	1	1	1	Per Semester				
Structure	Practice	0	0	0	Theory	Practical	IA	SEE	
	Tutorial	0	0	0	Theory	Fractical	IA.	JLL	
	Total	1	1	1	13	0	50 %	50 %	

COURSE OVERVIEW

This course describes the method used to document the procedures and tools used in testing or research and aims to describe the primary purpose of preparing an Engineering technical report. Also helps in preparing report that describes the progress, process, or results of scientific or technological research. It also covers how to prepare and include some recommendations and conclusions in report.

COURSE OBJECTIVES

- 1. To understand the purpose of technical documents/specifications.
- 2. To create effective technical documents.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

со	Course Outcomes	POs	PSOs
CO1	Create effective written documents after an audience analysis.	1,5,9,10,12	

CO2	Recognize various forms of technical communication and Select the most appropriate format to convey the technical information.	1,5,9,10,12	
CO3	Discuss the complex technical concepts lucidly for the common man to understand easily.	1,5,9,10,12	
CO4	Adhere to formatting, best practices and avoid pitfalls.	1,5,9,10,12	
CO5	Write formal reports detailing the process, result or progress of a project.	1,5,9,10,12	
CO6	Create visually appealing documents with the incorporation of design elements, enhancing the reading experience as well.	1,5,9,10,12	

CO2	Recog	gnize v	arious	forms o	f techr	nical co	mmun	ication	and Se	elect the	e most	1,5,9	,10,12		
CO3	Discu	ss the	comp	lex tech	nical c	oncept	s lucid	ly for t	he con	nmon n	nan to	1,5,9	,10,12		
CO4	Adhe	re to f	ormat	ing hes	t nract	ices ar	nd avoi	d nitfa	lls			159	10 12		
CO5	Write	forma	l repo	rts deta	iling th	e proce	ess. res	ult or r	orogres	s of a p	roiect.	1.5.9	.10.12		
CO2 CO3 CO4 CO5 CO6 BLOOM'S CO CO1 CO2 CO3 CO4 CO5 CO6 COGCOCOCCOCCOCCOCCOCCCCCCCCCCCCCCCC	Creat	e visu	ally ap	pealing	docur reading	nents g exper	with the	ne inco	rporati	ion of (design	1,5,9	,10,12		
BLOOM'S	LEVEL	OF THI	COU	RSE OU	гсом	S									
							Bloc	om's Le	evel						
со	Rei	memb	er	Unders (L2)	tand	А	pply (L3)		Analyz (L4)	ze	Eva (I	luate L5)		Create (L6)	9
CO1				V			\wedge								
CO2															
CO3	_			1			V								
CO4				1			7/	-/							
CO6					/		V								
COURSE A	RTICUI	LATION	I MAI	RIX			<u>/ </u>	$ \Lambda$							
CO/	H H	7	<u>κ</u>	4	ம	9			<u> </u>		11	12	11	22	8
POs	8	8	9	8	OG.	S.	_S	S	8	PO	. 00	6	PSC	PSC	PSC
CO1	1	/			1				1	3 /		1			
CO2	1				1				2	/3		1			
CO3	1 <	<			1				3/	3		1			
CO4	1			4 /	1				2	2		1			
CO5	1				1		<u> </u>		2	2		/ 1			
Average	1.2			/	1				2	2.6		1			
Note: 1-Lo	w. 2-N	l 1edium	 ո. 3-Hi	gh 〈		1									
CO3 CO4 CO5 CO6 Average Note: 1-Lo COURSE Co Introduction Research, Note application Research For Writing Research For Writing Research For Swayam, 1. Technication Ref: BOS/SM	ONTEN on: A k Writing ne Cont tion or	oasic ung the do	nderst ocume d Tech open-	anding onto	of the ropetitor port: Cools. Cr	cole of analysi Develop reating	Unit- a techr s and w bing Flo a techr Unit-	-1 writing wchart nical re	riter in own do cs, Block port usi	an orga cument diagra ing diffe	anizatio t. ms/sch erent st	on, Aud nemati tyling t	dience cs, Info echniq	Analysi graphic ues.	s, Topio
Precaution Research F Writing Res	in Int Report, search	erpreta Types Report	of Ress, Con	Significa ports, O clusions	nce of	Repor	t Writi	ng, Di	fferent s of W	Steps i	in Writ Resea	ting Re	eport ,	Layout Precaut	t of the
TEXT BOO	K nari, "R 'NPTEL al Writ	eseard -/MOC	h Met O Cs: ster C	hodolog ourse: h	gy- Me	thods a	and Ted	chnique /techn	es", Ne ical-wri	w Age I	Interna	ational	, 2 nd Ec	dition, 2	2015.
SWAYAM/ 1. Technica		R	eport	Wr	ting .	for	En	gineer	s 1	Γhe	Unive	ersity	of	Sh	neffield
SWAYAM/ 1. Technica 2. Technica https://	hnical www.f	futurel	earn.c	om/cou	rses/te	ecnnica	ıl-repoi	rt-writi	ng-tor-	engine	ers.				

co/)1)2	33	4	05	90	22	80	60	10	11	12	01	22	23
POs	PO	P02	g	<u>Q</u>	A	A .	P07	A	P09	PO	PO	P01	PS	PS02	PS03
CO1	1				1				1	3 /		1			
CO2	1				1)			2	3		1			
CO3	1 <	<			1	,			3 /	3 /		1			
CO4	1			/	1				(2	2		1			
CO5	2				1				2	2		1			
CO6	1				1				2	3		1			
Average	1.2		φ	/	1				2	2.6	,	1			

Course Title	Resear	ch Based Mi	ni Project		Cours	ве Туре	Hard	d Core
Course Code	B20ER0607	Credits	1		Cl	ass	VI Se	mester
	TLP	Credits	Contact	Work	Total N	umber of	٨٥٥٥٥	ment in
	ILP	Credits	Hours	Load	Cla	isses		ghtage
Course	Theory	0	0	0	Per Se	emester	vvei	gniage
Structure	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	1	2	2	0	26	50 %	50 %

(Olirse Litle	Resea	rch Based M	ini Project			Cours	e Tyne		Hard	d Core
Course Code	P20ED0607	Crodite	iiii Froject	<u> </u>		Cours	acc		VISO	mostor
Course Code	BZUEKU6U7	Credits	6	1 14/	1. 7	CI	ass		vi se	mester
	TLP	Credits	Hours	Load	d I	Cla	sses	T	Assess Wei	sment in
Course	Theory	0	0	0		Per Se	mester			
Structure	Practice	1	2	2	_	heory	Practic	al	IΑ	SFF
	Tutorial	0	0	0		,				
	Total	1	2	2		0	26	5	0 %	50 %
LOUKSE OVERVI	EVV		hant I						•	1-
mpress them. COURSE OBJECT To acquaint v problems. To inculcate the	Resea B20ER0607 TLP Theory Practice Tutorial Total EW ne of the integral ets by building prechnical skills likes in the process of self- MES (COs) tion of the course if y problems base y Knowledge and lop interpersonal of the proper inferrimental/simulation.	of applying	basic eng	o show	g func	dament	actical si	kills to	the re	cruiters and
After the comple	tion of the course	, the student	t will be ab	e to:	$\overline{}$					
со		Course Ou	ıtcomes					POs		PSOs
CO1 Ident	ify problems base	ed on societa	I /research	needs.		<u> </u>		1,6		1
CO2 Apply	Y Knowledge and	skill to solve	societal pro	oblems i	in a gr	oup.		1,2,3	,6	1,2
CO3 Deve	lop interpersonal	skills to wor	k as memb	er of a g	roup (or lead	er.	1,9,1	0	1,2
CO4 Draw expe	the proper infer rimental/simulati	ences from a ons.	ivailable re	sults the	rough	theore	tical/	1,2,5	5	1,2
CO5 Demo	onstrate project n	nanagement	principles	during p	roject	t work.		9.10,1	11	1,2
Comi CO6 with effec	municate effective the engineering tive reports and continuous tive reports and contin	ely the proce community lesign docum	and with nentation.	olve eng society	gineeri at la	ing pro	blems rough 1	,9,10,1	1,12	1,2
BLOOM'S LEVEL	OF THE COURSE	OUTCOMES								
			Bloc	m's Lev	rel					
CO Re	member Und	erstand	Apply		Analyz	e	Evalua	ate	Cı	reate
1	(L1)	(L2)	(L3)		(L4)		(L5))		(L6)
		√								
CO1			$\sqrt{}$							
CO1 CO2							1			
CO1 CO2 CO3			√ √		$\sqrt{}$					
CO1 CO2 CO3 CO4			V		√ √					
CO1 CO2 CO3 CO4 CO5			√ √		\[\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\chi}}}} \sqrt{\sqrt{\sqrt{\chi}}} \]					
CO1 CO2 CO3 CO4 CO5 CO6			√ √		\[\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\chi}}}} \sqrt{\sqrt{\sqrt{\chi}}} \]			V		
CO1 CO2 CO3 CO4 CO5 CO6	LATION MATRIX		√ √		\[\sqrt{\sq}}}}}}}\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sq}}}}}}}\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sq}}}}}}}\sqrt{\sintitita}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}}			√		
CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTICU	LATION MATRIX	2 8	00 00	80	√ √ √ √	010	110)12 	100	203
CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTICU CO / POs CO1 CO / POs CO2 CO2 CO3 CO4 CO5 CO6 COURSE ARTICU CO / POs CO	LATION MATRIX	PO5	P06	P08	√ √ √ √ √	PO10	P011	P012	PS01	PSO2 PSO3
CO1 CO2 CO3 CO4 CO5 CO6 COURSE ARTICU CO / POs CO1 3	LATION MATRIX O O O O O O O O O O O O O	PO	90 60	PO8	√ √ √ √ √ √ √ √ √ √ √ √ √ √ √ √ √ √ √	PO10	P011	P012	3 3 3	PSO2 PSO3
Course Title Course Code Course Structure COURSE OVERVI Mini project is or equip new skill standard to the transfer of the colving problems impress them. COURSE OBJECT 1. To acquaint to problems. 2. To inculcate the complete of the course outcome outcom	LATION MATRIX Solve Sol	PO5	90 0	80d	909 1	PO10	PO11	P012	3 3 3	2 2

			Bloom's	Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√	, ,			
CO2			√			
CO3			√	V		
CO4				V		
CO5				$\sqrt{}$		
CO6				$\sqrt{}$	√	

CO / POs	P01	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3					2							3		
CO2	3	3	2			2							3	2	
CO3	1								3	3			3	2	

CO4	1		2	3							3	2	
CO5							3	2	3		3	2	
CO6	1						3	3	2	2	3	2	
Average	1.8	3	2	3	2		3	2.6	2.5	2	3	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Research based project is aim to identify the research gap though extensive literature survey on a recent trends in mechanical engineering and allied areas. The research focus may be on modelling, simulation, experimental & analysis, model/prototype design, fabrication of new equipment, analysis of data, software development, etc. or a combination of these. Through this the team should publish a review research paper in the selected field of study.

The students have to make a project team consisting of two, three or four members. Every student in a group shall take up a project in the beginning of sixth semester in consultation with the guide and the project must be completed before the end of semester. The project team has to work to identify the research gap though extensive literature survey on a recent trends in mechanical engineering and allied areas and formulate the problem statement. The team submit a report prepared as per the guidelines/format of the university (one report per group).

TEXT BOOKS

- 1. Biswajit Mallick, "Innovative Engineering Projects", Entertinement Science and Technology Publication, Bhubaneswar, India, 1st Edition 2015.
- 2. C R Kothari, "Research Methodology- Methods and Techniques", New Age International, 2nd Edition, 2015.
- 3. A.K. Chitale, R.C. Gupta, "Product Design and Manufacturing", Prentice Hall of India, Sixth Edition, 2013.

REFERENCE BOOKS

1. O. Molloy, S. Tilley and E. A. Warman, "Design for Manufacturing and Assembly: Concepts, Architectures and Implementation", Springer. USA, 2012.

- 2. Boothroyd, G.Peter Dewhurst and Winston A, "Knight, Product Design for Manufacture and Assembly", CRC Press, Taylor & Francis, Third Edition, 2010.
- 4. Navi Radjou, Jaideep Prabhu and Simone Ahuja, "JUGAAD Innovation: A Frugal and Flexible Approach to Innovation for the 21st Century", Random house India, Noida, 2012.
- 5. Karl T. Ulrich and Steven D. Eppinger, "Product Design and Development", McGraw-Hill, Sixth Edition, 2015.

JOURNALS/MAGAZINES

- 1. Global Innovative research Journal: https://freeprojectsforall.com/journal-publication/
- 2. International Journal of Project Management: https://www.journals.elsevier.com/international-journal-of-project-management

SWAYAM/NPTEL/MOOCs:

1. Project Management: https://nptel.ac.in/courses/110104073

Course Title	Vibratio	ns and Nois	e Engine	ering	Cour	se Type	Hard	d Core
Course Code	B20ER0701	Credits	3	3	С	lass	VII se	mester
	TLP	Credits	Contact	Work	Total N	umber of	Accoca	mont in
	I LF	Credits	Hours	Load	Cla	Classes Assessment Weightage		
Course	Theory	2	2	2	Per Se	emester	vvei	giitage
Structure	Practical	0	0	0	Thoony	Tutorial	IA	SEE
	Tutorial	1	2	2	Theory	Tutoriai	IA	SEE
	Total	3	4	4	26	26	50 %	50 %

			Bloom	's Level		
со	Remember	Understand	Apply	Analyze	Evaluate	Create
	(L1)	(L2)	(L3)	(L4)	(L5)	(L6)
CO1		✓				
CO2			✓			
CO3				✓		
CO4				✓		
CO5			✓			
CO6			✓			

COURSE ARTIC	ICULA ⁻	TION	MATR	IX											
CO/ POs	P01	P02	P03	P04	P05	90d	P07	P08	P09	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	3	2	1									3	3	
CO2	3	3	2			1	Unit-1 mple Harmonic Motion (S.H.M.), Work done by harmonic force sedom Systems: Derivations for spring mass systems, Methods ams, Springs in series and parallel, Torsional and transverse Unit-2 om Systems: Types of damping, Analysis with viscous damping systems, Logarithmic decrement, numerical. stems: Introduction, Analysis of forced vibration with constant in gand reciprocating unbalances, excitation of support (relative smissibility, Energy dissipated due to damping, numerical. Unit-3 frequency measuring instrument, whirling of shafts with and diplow critical speed of shafts, numerical. Sr. Principle modes of vibrations, Normal mode and natural inple spring mass systems, masses on tightly stretched strings, rectilinear and angular systems, Undamped dynamic vibration Unit-4 Frequency and sound dependent human response; the decibel (SPL), sound power level and sound intensity scale; relationship ound spectra and Octave band analysis; loudness; weighting its of noise; hazardous noise, exposure due to machines and k-criteria, daily noise doze. uding the vibration of single degree freedom systems. esponse of single degree and multi Degree spring mass system. hicle (2 DOF). variation of stiffness/Damping. ucation Inc, 6th Edition, 2016. Vibrations ", Schaum's outline Series, Tata McGraw Hill.								
CO4	3	ULATION MATRIX													
COURSE ARTICULATION MATRIX CO															
CO6	3	2	1			1							3	3	
Average	3	2.8	1.8	1.5		1							3	3	
Note: 1-Low, 2	2-Med	dium,	3-High	ı											
Introduction: Undamped Fr of Analysis, N vibrations, Eff	: Types ree Vil Natura fect of	es of vi ibrational al frections	ibration on - Sir quencion s of spr	ns, Def ngle De es of s ring, no	inition gree o imple imerica	s, Simp of Free systen al.	Unit- ole Hardom Syns, Spr	nonic I estems: ings in	Motion Deriva	(S.H.N ations f and p	л.), Wo for spri parallel	ork don ng ma: , Torsi	ie by ha ss syste onal a	armoni ems, M nd trar	c force ethods nsverse
Damped free	vibrat	ations-	- Single	e Degre	ee of F	reedor	n Svste	ems: Tv	pes of	dampi	ng. Ana	alvsis w	vith vis	cous da	amping
- Derivations f	for ove	er, cri	itical a	nd und	er dan	nped sy	stems	, Logari	ithmic	decren	nent, n	umerio	cal.		O, 1.4
Forced vibrati	tion - S	Single	Degre	e of F	reedor	n Syste	ms: In	troduc	tion, A	nalysis	of for	ed vib	ration	with co	onstant
harmonic exci	itation	n- ma	gnifica	tion fa	ctor, ro	otating	and re	ciproca	iting ur	nbaland	ces, ex	citation	of sup	oport (r	elative
and absolute a	amplit	itudes), force	e and n	notion	transn	nissibili	ty, Ene	rgy dis	sipate	d due t	o damı	ping, n	umeric	al.
Vibration Ma			has Cair	maio in	ct v	, t	Unit-	3	in	in atrium	ant i	ubirlid.	, of sh	ofte wi	اممد ط±
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TEXT BOOKS		anical	Vibrat	ions",	Pearso	n Educ	ation I	nc, 6 th l	Edition	, 2016	•				
TEXT BOOKS 1. S. S. Rao, "N	Mecha	//-	damen [.]	tals of	Mecha	inical V	'ibratio	ns ", So	chaum'	's outli	ne Seri	es, Tat	a McG	raw Hil	l.
1. S. S. Rao, "N 2. S. Graham R	Mecha Kelly,	"Func				_									
1. S. S. Rao, "N 2. S. Graham H 3. W. T. Thom	Mecha Kelly, nson, "	"Mech	nanical	Vibrat	ions",	Pearso	n Educ	ation l	nc, 5 th l	Edition	, 2008				

4. C Sujatha, "Vibrations and Acoustics - Measurements and signal", Tata McGraw Hill.

REFERENCE BOOKS

1. W. T. Thomson, "Theory of Vibration with Applications", Pearson Education Inc, 5th edition, 2008.

- 2. V. P. Singh, "Mechanical Vibrations", Dhanpat Rai & Company, 3rd Edition, 2006.
- 3. Amberkar A.G, Mechanical Vibrations and Noise Engineering, PHI Learning Pvt. Ltd, 2006.

JOURNALS/MAGAZINES

- 1. Journal of Sound and Vibration
- 2. Noise & Vibration Worldwide SAGE Journals
- 3. Journal of Vibration and Acoustics
- 4. Journal of Vibration Engineering & Technologies
- 5. https://www.inceusa.org/publications/noise-news-international

SWAYAM/NPTEL/MOOCs

- 1. https://nptel.ac.in/courses/112107212 (Introduction to Mechanical Vibration)
- 2. https://nptel.ac.in/courses/112104194 (Basics of Noise and Its Measurements)
- 3. https://www.classcentral.com/course/swayam-sound-and-structural-vibration-58554
- 4. https://onlinecourses.nptel.ac.in/noc22_me34/preview (Sound and Structural Vibration)

Course Title		CAD/CAM/C	M		Cour	se Type	Hard	d Core
Course Code	B20ER0702	Credits		3	С	lass	VII se	mester
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in
Course	Theory	2	/ 2	2	Per Se	emester	vvei	giilage
Structure	Practice	0	0	0	Theory	Tutorial	IA	SEE
	Tutorial	1	3	3	THEOTY	Tutorial	IA	SEE
	Total	/3	5	<u></u>	26	39	50 %	50 %

COURSE OVERVIEW

This subject explores with the technology related to the use of digital computers to perform design activities and manufacturing activities in an organization, the basic concepts and applications of conventional numerical control along with NC part programming. This course also focuses on computer technology to automate each and every function starting from market information, production processed, design activities, materials, commercial, financial required for the industry. It also deals with the reliability and performance of automated flow line involving three methods of line balancing of minimizing the total amount of idle time for a given job at a given assembly line speed.

COURSE OBJECTIVES

- 1. To obtain the fundamentals of CAD/ CAM / CIM and related concepts to understand the various modeling features and its manufacturing.
- 2. Interpret various concepts of CAD /CAM /CIM, the product development cycle can be reduced in the design stages and also reduction of Manufacturing Lead time.
- 3. Developing the NC programming and its importance in practical applications by using coding system.
- 4. To have a hands on experience on various tools used for modeling and manufacturing aspects.
- 5. To study about the line balancing in automated flow lines.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

co	Course Outcomes	POs	PSOs
1 (() 1	Apply the basic principles of CAD/ CAM to create 3D models of real-world products before they are ever manufactured.	1,2,3,5	1,2
CO2	Develop the manual NC part programming for given profile.	1,2,3,5	1,2
CO3	Identify the suitable type of automation for different production systems.	1,2	1,2
CO4	Criticize the mathematical model used in production system.	1,2	1,2
CO5	Analyze the various work transport system used in high volume production.	1,2	1,2

CO6	Formulate the line balancing of an automated assembly lines and understand	1,2	1.2
	advanced emerging technologies used in manufacturing.		1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

			Bloom	r's Level		
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			✓			
CO2			√			
CO3		✓				
CO4			√			
CO5				✓		
CO6			✓			

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	P02	PO3	P04	PO5	P06	P07	PO8	P09	PO10	PO11	PO12	PS01	PS02	PS03
CO1	3	2	1		1								3	2	
CO2	3	2	1		1								3	2	
CO3	3	2		/	/								3	2	
CO4	3	2											3	2	
CO5	3	2					\wedge						3	2	
CO6	3	2											3	2	
Average	3	2/	1		1								3	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Fundamentals of CAD: Definition of CAD/CAM/CIM, Product cycle and its cad / cam over laid, Design process & application of computers for design, creating the manufacturing database, Benefits of CAD/CAM/CIM.

Computer Graphics: Coordinate Systems, Database Structure for Graphic Modeling, functions of graphics package, Transformation of geometry, 2D transformations – Simple problems. Geometric Modeling, types, Windowing and clipping.

Unit-2

Introduction to NC Technology Basic components of NC system, NC Coordinate system, types of NC motion control systems, advantages and applications of NC. CNC & DNC Systems: Types, advantages and its functions. Adaptive control systems.

NC/CNC Programming: NC Procedure, Manual programming and computer assisted part programming, syntax formats in part programming, G & M codes, Cutter Radius Offset, Tool Length Offset, Fixed Cycles/canned cycles, Turning and milling programs. (Using CAM software demonstrate turning and milling operations).

Unit-3

Computer Integrated Manufacturing System: Introduction to CIM and Automation, types of Automation, Model of manufacturing, Information processing cycle in manufacturing, Types of Production systems, Production Concepts & its Mathematical models, Problems. Automation Strategies.

Introduction and Analysis of Automated Flow Line: High Volume Production system: Introduction, Automated flow line, Work part transport, Buffer storage and its control functions. General terminology and analysis, Analysis of Transfer line with and without storage, numerical.

Unit-4

Assembly and Line balancing: Types of assembly system, minimum rational work element, cycle time, precedence constraints and diagram, balance delay. Methods of Line balancing – Largest candidate rule (LCR), Kilbridge and westers method, ranked positional weight method, numerical only on LCR and RPW.

Advanced Techniques in Manufacturing: Smart manufacturing, digital manufacturing, intelligent manufacturing, internet of things, cloud based manufacturing, cloud computing for manufacturing, web based manufacturing.

Practice in Tutorial Session

SI. No	Title	Tools and Techniques	Expected Skill /Ability
1.	Autodesk Fusion 360 Basics	-	Application of Autodesk Fusion
2.	3D Modeling in Fusion 360	Familiar with Extrude, Fillet, chamfer, revolve, sweep, combine tools.	Create 3D models of real- world products before
3	3D Modeling in Fusion 360 – Creating and Modifying Solid Bodies	Familiar with Loft, Sculpt, Patch, Replace Face, Thicken	they are ever manufactured

Note:

- After having hand on experience on 3D Modeling in Autodesk Fusion 360, student is expected to develop concept model and prepare product design of automotive components, domestic components Household products, aerospace components, etc.
- 2. First three to four weeks will be hands-on training on 3D Modeling in Fusion 360 will be given to students.
- In remaining tutorial session each student is expected to develop concept and prepare a model of automotive components, household products and aerospace components. (At least one each segment).

4. Performance in tutorial session will be evaluated for 20 Marks.

TEXT BOOKS

- 1. M.P.Groover and Emory W.Zimmer, "CAD/CAM, Computer Aided Design and Manufacturing", Pearson India, 2nd Edition. 2007
- 2. Mikell P.Groover, "Automation, Production System & Computer Integrated Manufacturing", Pearson India, 2nd Edition. 2007

REFERENCE BOOKS

- 1. Ibrahim Zeid, "CAD/CAM theory and practice", Tata McGraw Hill. 2007.
- 2. P. Radha Krishnan, S. Subramanyan & V. Raju, "CAD/CAM/CIM", New Age international Publishers, 2nd Edition. 2008.
- 3. P. Radha Krishnan, "Computer Numerical Control Machines and CAM", New Age international Publishers, 1st Edition 2012.
- 4. P. N. Rao, "CAD/CAM Principles and applications", Tata McGraw Hill.2010.

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/journal/Computer Aided Design
- 2. https://www.sciencedirect.com/journal/Advancements in CAD/CAM technology: Options for practical implementation

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/112102102
- 2. https://nptel.ac.in/courses/112104289

Course Title	Mechatror	nics and Con	trol Syste	ems	Cours	se Type	Hard	d Core
Course Code	B20ER0703	Credits	3	3	С	lass	VII se	mester
	TLP	Credits	Contact	Work	Total N	umber of	٨٠٠٥٠	sment in
	ILF	Credits	Hours	Load	Cla	asses		ghtage
Course	Theory	3	3	3	Per Se	emester	vvei	giitage
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

Course Title	Mechat	ronics and Cor	ntrol Syste	ems	Cours	ве Туре	Hard	d Core
Course Code	B20ER070	3 Credits	3	3	C	lass	VII se	mester
	TLP	Credits	Contact	Work Load	Total N	umber of	Assess	sment in
Course	Theory	3	3	3	Per Se	emester	Wei	ghtage
Structure	Practice	0	0	0	1 61 50	cotci		
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %
COURSE OVERVIEW	1							
Course Title Course Code Course Structure COURSE OVERVIEW This course focuses and transducer use information about si provides knowledge and electrical system. COURSE OBJECTIVES 1. To understand wa 2. To acquire the kn 3. To understand wa 4. To develop the sk 5. To study the stabic COURSE OUTCOMES After the completion CO CO1 Identify the transducer out actuator/driv Understand CO3 CO4 Develop math system. CO5 Perform time CO6 Explain work actuator/driv Understand conditioning mechatronics system. CO7 CO9 CO1 CO1 CO2 CO3 CO4 CO5 CO6 Ref: BOS/SME/BME-2020	d for measurignal condition on control enterior aspects owledge on the cours of the cours where the concept of	ement and dening devices and ingineering above the students of mechatronic ransducers, see all conditioning matical modelia by using R H conditioning to the student of the design of signal programmer of systems and dels and transport tr	etecting to and micro of given not of given	he input controlle matical tand the actuator nd micro alysis of d root lo le to:	signal forms to be used modeling time responses controllers system us technical and select mics system in the users in the cechanical and second controllers in	r various apsed in mechand analysis onse ana	poplications atronics described in the state of mechanis and state of main POS 1,2 1,2 1,2,3 1,2,3	PSOs 1,3 1,2,3
CO5 Perform time	response and	lysis of first ar	nd second	order sy	stem.		1,2,3	1,2,3
CO6 Examine the splot.	stability of the	e system using	Routh's-H	Hurwitz (Criterion a	nd root locu	1,2,3	1,2,3
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CO2							+	
CO3		-	./					
CO4			v		./			
COS							-	
CO5					V			
COB					√			
<u> </u>	l	1		1		l	l	

			Bloom	's Level		
СО	Remember	Understand	Apply	Analyze	Evaluate	Create
	(L1)	(L2)	(L3)	(L4)	(L5)	(L6)
CO1		✓				
CO2		√				
CO3			√			
CO4				✓		
CO5				✓		
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/)1)2	33	94	95	P06	70	P08	P09	010	11	12	01	02	PS03
POs	8	8	8	Š.	9	Δ	P07	Δ	Δ	PO	P01	P01	PSO	PS	PS
CO1	2	2											3	1	2
CO2	2	2											3	1	2
CO3	3	2	2										3	2	2
CO4	3	3	2										3	3	2
CO5	3	3	2										3	3	2
CO6	3	3	1		1								3	3	2
Average	2.6	2.5	1.7		1								3	2.1	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Mechatronics Systems and Actuators: Definition of mechatronics, components of mechatronics, Basic Terminologies, Open loop and Closed loop control systems, microprocessor based control systems, ATM, Washing machine, Static and dynamic characteristics of sensor, Capacitance sensor, Eddy current sensor, Hall effect sensor-Light sensors, optical encoders, Actuation System- mechanical-Electro mechanical, electrical switches, solid state switches, solenoid.

Unit-2

Drives: AC, DC, Servo motors, stepper motors, hybrid motors.

Signal Conditioning Devices: amplifier, filters, multiplexers, de multiplexers, ADC, DAC.

Micro Controllers: Introduction, classification of micro controllers and its application, Arduino processor-Introduction, Architecture and application.

Únit-3

Introduction to Mechanical System Modeling: Real time applications, Transfer Functions- models of mechanical systems (translational and rotational) and electrical systems, Introduction to block diagram and signal flow graph.

Time Response Analysis: Types of inputs, first order and second order system response to step input, time response specifications and concepts of time constant, numerical problems.

Unit-4

Stability Analysis: Routh's-Hurwitz Criterion, stability analysis using root locus plots, Introduction to PI, PD and PID controllers.

CASE STUDIES

- 1. Mathematical modeling of shock absorber used in Indian Automobile vehicles.
- 2. Time response analysis of shock absorber using Matlab / Simulink software.
- 3. Stability analysis by constructing root locus plot using Matlab / Python Code.

TEXT BOOKS

- 1. Katsuhiko Ogata, "Modern Control Engineering", Pearson Education, 5th Edition, 2021.
- 2. W.Bolton "Mechatronics", Pearson Publications, 7th Edition, 2018.
- 3. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 6th Edition, 2017.

REFERENCE BOOKS

- 1 Devdas shetty and Richard A. Kolk "Mechatronics System Design" Cengage Learning, 2nd Edition, 2011.
- 2. B.C.Kuo, F.Golnaraghi "Automatic Control Systems", John Wiley & Sons, 9th Edition 2014.
- 3. Richard C Dorf & Robert H Bishop," Modern Control Systems", Prentice Hall, 13th Edition, 2016.

JOURNALS/MAGAZINES

- 1. https://www.journals.elsevier.com/mechatronics
- 2. https://www.sciencedirect.com/journal/mechatronics
- 3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=87

Course Title	Engineering	g Economics a Managemer		ncial	Cours	se Type	Hard	d Core
Course Code	B20ER0704	Credits		3	С	lass	VII se	mester
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in
Course	Theory	3	3	3	Per Se	emester	vvei	ghtage
Structure	Practice	0	0/	0	Theory	Practical	IA	SEE
	Tutorial	0	O	0	inediy	Fractical	IA	JEL
	Total	3 _	3	3 ^	39	0	50 %	50 %

SWAYAM/NPTEL/ 1. https://nptel.ac 2. https://www.cla	/MOOCs: in/courses/112 asscentral.com/	2103174						
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		course/swaya	m-mechatr	onics-2	3047			
3. https://nptel.ac	i.in/courses/107	7106081	1		104 6			
4. nttps://www.ed	ıx.org/course/d	ynamics-contr	oı-upvalen	cıax-dc2	ZUIX-Ü			
Course Title	Engineer	ring Economic	s and Finan	cial	Cours	e Type	Har	d Core
	B22=	Manageme	ent -		220.0	7		
Course Code	B20ER0704	4 Credits	Contact	Mark	Total Ni	ass umber of	VII se	emester
	TLP	Credits	Hours	Load	Cla	sses	Assess	sment in ghtage
Course	Theory	3	3	3	Per Se	mester		1
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %
COURSE OVERVIE	w			-				1
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			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2				✓		
CO3			✓			

CO4		✓		
CO5		✓		
CO6		✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	90d	PO7	PO8	P09	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3								1		1		1	3	
CO2	3	3									3	1	1	3	
CO3	3	3	2	1					1		3	1	1	3	
CO4	3	3	2	1							3	1	1	3	
CO5	3	3	1								3		1	3	
CO6	3	3									3		1	3	
Average	3	3	1.6	1					1		2.6	1	1	3	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Engineering Economy: Introduction to Indian Economy, Basic terminologies used in economy, Engineering Decision- Makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics and Strategy. Law of demand and supply, Interest and Interest factors: Interest rate, Cash – flow diagrams, numerical.

Present-Worth Comparisons: Conditions for present worth comparisons, Basic Present worth Comparisons, Present-worth equivalence, Net Present worth, Assets with unequal lives, infinite Lives, Future-worth comparison, Simple Exercises.

Unit-2

Evaluation of Projects and Depreciation: Annual worth method, and internal rate of return method. Numerical covering all the above method with comparisons. Rate-of-Return Calculations, Minimum acceptable rate of Return, ERR, IRR.

Depreciation: Causes of Depreciation, Methods of depreciation. Simple Numerical, Tax- Direct and Indirect tax, GST and simple concepts of taxing.

Unit-3

Estimation, Costing and Final Accounts: Estimation for simple components (with calculations of all types of costs involved in it). Introduction, Scope of Finance, and Finance Functions, Statements of Financial Information: Source of financial information, financial statements, Balance sheet, Profit and Loss Account, relation between Balance sheet and Profit and Loss account, Numerical.

Unit-4

Financial Ratio Analysis: Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm's earning power, numerical.

Profit Planning: Financial planning, Profit planning, Objectives of Profit planning, type of budgets in Indian Economy, preparation of Budgets, advantages, problems on flexible budget, cash budget and production budget.

CASE STUDIES:

- 1. Computation of different financial ratios for various sectors by using current financial annual report.
- 2. Comparison of the quarterly results of various manufacturing and IT sectors for the financial year and preparation of the financial statement with total revenue and Net profit.
- 3. SWOT analysis of Manufacturing sectors and Interpretation of opinions for the Investors.

TEXT BOOKS

- 1. R Paneerselvam, "Engineering Economy", PHI Publishers, 2nd Edition, 2013.
- 2. Thuesen H.G. "Engineering Economy", PHI, 9th Edition, 2002.

Course Title	IoT and Machin	ne Learning i	n Manufa	acturing	Cours	е Туре	Soft Core	
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	Tutorial	/ 0 ^	0	0 _	Theory Practical		IA	SEE
	Total	3	3 /	3	39	0	50 %	50 %

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REFERENCE ROOKS								
1 Riggs II "Fngine	ering Economy	v" McGraw I	Hill 4 th editio	n 2002	2			
2. O P Khanna. "Indi	ustrial Enginee	ring and Mar	nagement". D	hanpa	 t Rai & So	ns. 2018		
3. Prasanna Chandra	a, "Financial M	lanagement"	, TMH, 10 th E	dition,	2019.			
4. IM Pandey, "Finar	ncial Managen	nent", Pearso	on, 12 th Editio	n, 202	1.			
JOURNALS/MAGAZ	ZINES							
1. https://www.scie	ncedirect.com	/journal/jou	rnal-of-mater	ials-sci	ence-and	technology		
2. https://www.scie	ncedirect.com	/journal/jou	rnal-of-mater	ials-sci	ence-and-	technology		
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	Bloom's Level											
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)						
CO1	٧											

CO2		٧			
CO3	٧				
CO4			٧		
CO5			٧		
CO6			٧		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	50d	90d	PO7	PO8	60d	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3												3	3	
CO2	3	2											3	3	
CO3	3												3	3	
CO4	3	2			1								3	3	
CO5	3	2			1								3	3	
CO6	3	2			1								3	3	
Average	3	2			1								3	3	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to IoT: Definition – Significance of IoT, Characteristics of IoT-Physical Design of IoT – Logical Design of IoT- IoT enabling technologies, Scope–Sensors for IoT Applications–Structure of IoT – IoT Map Device.

M2M to IoT: A Basic Perspective—Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

Unit-2

M2M to IoT-An Architectural Overview:

Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. IoT Device – Basic building blocks of an IoT Device – Exemplary Device: Raspberry Pi

IoT Platforms Design Methodology:

Introduction – IoT Design Methodology, concept of the Industrial Internet of Things – Case study IoT enables CNC Machining, Real time machine monitoring.

Unit-3

Introduction to Machine Learning: Machine Learning basics, challenges, Applications, methods of Machine Learning, performance metrics, Data preprocessing, Data Loading, Understanding data with statistics, understanding data with visualization, preparing data, data feature selection.

Unit-4

Supervised Learning – Performance metrics: accuracy, misclassification, confusion matrix, similarity/dissimilarity methods, Decision Tree, K-nearest neighbor, logistic regression, support vector machine algorithm, naive Bayes algorithm, bagging and boosting techniques: random forest algorithm.

Identification of Optimal Parameters using supervised learning techniques, Build an optimization model to study the metal cutting parameters using machine learning.

TEXT BOOKS

- 1. Arshadeep Bahaga, Vijay Madisetti,"Internet of things-A hands –on approach", Universities Press, 1st Edition, 2015
- 2. Adrian McEwen and Hakim Cassimally,"Designing the Internet of Things", Wiley, 1st Edition, 2014.
- 3. Russell & Norvig, "Artificial Intelligence: A Modern Approach", Prentice-Hall, 3rd Edition, 2010.
- 4. Tom Mitchell, "Machine Learning", McGraw-Hill, 1st Edition, 2017.

REFERENCE BOOKS

- 1. Dominique DGuinard and Vlad M.Trifa,"Building the Web of things with examples in Node.js and Raspberry Pi", Manning Publications Co, 2016.
- 2. Elaine Rich, Kevin Knight, "Artificial Intelligence", TataMcgraw Hill, 3rd Edition, 2009
- 3. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

JOURNALS/MAGAZINES

1. https://www.sciencedirect.com/journal/artificial-intelligence

Course Title	Robotic Syster	ns Dynamics	and Con	trol	Cours	se Туре	Sof	t Core	
Course Code	B20ERS712	Credits	3	3	С	lass	VII se	mester	
	TLP	Credits	Contact	Work	Total N	Total Number of		mont in	
	ILF	Credits	Hours	Load	Cla	asses	Assessment in Weightage		
Course	Theory	3	3	3	Per Se	emester	vvei	giilage	
Structure	Practice	0	0	0	Thoony	Dractical	IA	SEE	
	Tutorial	0	0	0	Theory Practical		IA	SEE	
	Total	3	3	3	39	0	50 %	50 %	

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2. https://www.jair.	.org/index.php/j፡ ለበበር s	air						
1. https://nptel.ac.ii	n/courses/10610)5077						
2. https://onlinecou	urses.nptel.ac.in/	noc22_ge2	9/preview					
Course Title	Robotic Syste	ms Dynam	ics and Con	trol	Cours	e Type	Soft	Core
Course Code	B20ERS712	Credits	3	3	CI	ass	VII se	mester
	TI 0	6 10	Contact	Work	Total N	umber of		
	ILP	Credits	Hours	Load	Cla	sses	Assess	ment in
Course	Theory	3	3	3	Per Se	emester	weig	gniage
Structure	Practice	0	0	0	Theory	Practical	IA	SFF
	Tutorial	0	0	0			., \	
	Total	3	3	3	39	0	50 %	50 %
COURSE OVERVIEW Robot Dynamics is r	/: really important	since it will	give you a	complete	e understa	anding not o	nly how ro	bots move
(kinematics) but also	o WHY they mov	e (dynamics	s). In this co	urse, yo	u will learr	n to develop	the dynam	nics models
of basic robotic syst	tems, as well as o	reate intell	igent contro	ollers for	them.	•		
COURSE OBJECTIVE	S							
1. To control both the	he position and	orientation	of the tool	n the th	ree dimen	sional space	2 .	
2. The relationship b	between the joir	t variables	and the pos	sition an	d the orie	ntation of th	e tool.	
3. Planning trajector	ries for the tool t	to tollow or	order to p	ertorm n	neaningfu	i tasks.		
COURSE OUTCOME	roi the high spee S (COs)	u motion o	i the systen	1.				
After the completion	on of the course	the student	t will be able	e to:				
		Course	Outcomes			$\langle \cdot \rangle$	POs	PS∩s
Apply the tra	ansformation me	thods for de	efining new	position	and orien	tation of the	103	1303
cO1 objects in 3 c	dimensional spac	æ.					1,2	1,2
CO2 Understand I	Langrangian equ	ation of mo	tions and li	nk tenso	rc		1 2	
		7 - 7		1 1.	113.		1,2	1,2
CO3 Apply the kn	owledge of Lagra	ange-Euler	dynamic mo	del to d	ifferent ax	is robots.	1,2	1,2
CO3 Apply the kno	owledge of Lagra e plan of traject	ories for th	dynamic mo	odel to d	ifferent axors to perf	is robots.	1,2	1,2 1,2 1,2
CO3 Apply the known CO4 Elaborate the task. CO5 Identify work	owledge of Lagra e plan of traject kspace and work	ories for th	dynamic mo	d effecto	ifferent axors to perf	kis robots.	1,2	1,2 1,2 1,2
CO3 Apply the known and co4 Elaborate the task. CO5 Identify work Apply Langra	owledge of Lagra e plan of traject kspace and work angian mechanic	ories for the envelope for solve do	dynamic modern robot endored for different dynamic equ	odel to d d effecto types of ation of	ifferent axors to perform frobots.	cis robots. form specific	1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2
CO3 Apply the known and the cost of the co	owledge of Lagra e plan of traject kspace and work angian mechanic	envelope for to solve de	dynamic mo ne robot end for different ynamic equ	del to d d effecto types of ation of	ifferent ax ors to perf f robots. planer an	cis robots. Form specific	1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2
CO3 Apply the know task. CO4 Elaborate the task. CO5 Identify work Apply Langra robot. BLOOM'S LEVELOF	owledge of Lagra e plan of traject kspace and work angian mechanica	envelope for to solve de	dynamic mo ne robot end or different ynamic equ	types of	ifferent axors to perform frobots. planer an	cis robots. form specific	1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2
CO3 Apply the know task. CO5 Identify work co6 Apply Langra robot. BLOOM'S LEVELOF	owledge of Lagra e plan of traject kspace and work angian mechanica THECOURSE OU member Und	envelope for the sto solve described by the sto solve described by the storage of	dynamic moder robot endor different ynamic equence Blo Apply	types of ation of om's Lev	ifferent avors to perfore to perf	d articulated	1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create
CO3 Apply the know Elaborate the task. CO5 Identify work Apply Langra robot. BLOOM'S LEVELOF CO Ren	owledge of Lagra e plan of traject kspace and work angian mechanics THECOURSE OUT member Und (L1)	envelope for the sto solve de TCOMES erstand (L2)	dynamic moder robot endor different ynamic equence Blo Apply (L3)	types of ation of	ifferent axors to perform frobots. planer an vel Analyze (L4)	d articulated Evalua (L5)	1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
CO3 Apply the know task. CO5 Identify work robot. CO6 Apply Langra robot. CO7 Ren CO Ren	owledge of Lagra e plan of traject kspace and work angian mechanica THECOURSE OU member Und (L1)	envelope for the sto solve described (L2)	dynamic moder robot ender robo	types of ation of	ifferent axors to perform frobots. planer an vel Analyze (L4)	d articulated Evalua (L5)	1,2 1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
CO3 Apply the know Elaborate the task. CO5 Identify work Apply Langra robot. BLOOM'S LEVELOF CO Ren CO1 CO2	owledge of Lagra e plan of traject kspace and work angian mechanics THECOURSE OUT member Und (L1)	envelope for the sto solve de s	dynamic moder robot endored for different diff	types of ation of	ifferent axors to perform to perform to perform the performance of the	d articulated Evalua (L5)	1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
CO3 Apply the know task. CO4 Elaborate the task. CO5 Identify work robot. CO6 Apply Langra robot. BLOOM'S LEVELOF TO Ren CO1 CO2 CO3	owledge of Lagra e plan of traject kspace and work angian mechanics THECOURSE OU member	envelope for the envelope for the sto solve de TCOMES erstand (L2)	dynamic mode robot ender of different differen	odel to deffector types of ation of	ifferent avors to perform to perf	cis robots. form specific d articulated Evalua (L5)	1,2 1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
CO3 Apply the known and the task. CO5 Identify work apply Langra robot. BLOOM'S LEVELOF CO Ren CO1 CO2 CO3 CO4	owledge of Lagra e plan of traject kspace and work angian mechanics THECOURSE OU member Und (L1)	envelope for the envelope for the sto solve de TCOMES TCOMES TCOMES	dynamic moder robot ender robo	types of ation of	ifferent ayors to perform frobots. planer an vel Analyze (L4)	cis robots. Corm specific d articulated (L5)	1,2 1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
CO3 Apply the know task. CO5 Identify work robot. CO6 Apply Langrate robot. CO7 Ren CO1 CO2 CO3 CO4 CO5	owledge of Lagra e plan of traject kspace and work angian mechanics THECOURSE OU member	envelope for the envelope for the sto solve de TCOMES erstand (L2)	dynamic mode robot ender of different differen	types of ation of	ifferent avors to perform to perf	ets robots. Form specific d articulated (L5)	1,2 1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
CO3 Apply the known and the task. CO5 Identify work apply Langra robot. BLOOM'S LEVELOF CO Ren CO1 CO2 CO3 CO4 CO5 CO6	owledge of Lagra e plan of traject kspace and work angian mechanics THECOURSE OU member Und (L1)	envelope for the sto solve described (L2)	Blo Apply (L3)	types of ation of	ifferent ayors to perform frobots. planer an vel Analyze (L4)	Evalua (L5)	1,2 1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
CO3 Apply the know task. CO5 Identify work robot. BLOOM'S LEVELOF CO Ren CO1 CO2 CO3 CO4 CO5 CO6	owledge of Lagra e plan of traject kspace and work angian mechanica THECOURSE OU member Und (L1)	envelope for the envelope for the sto solve described (L2)	Blo Apply (L3)	types of ation of	ifferent ay ors to perf f robots. planer an wel Analyze (L4)	Evalua (L5)	1,2 1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
CO3 Apply the know task. CO5 Identify work robot. CO6 Apply Langrate robot. CO7 Ren CO1 CO2 CO3 CO4 CO5 CO6	e plan of traject kspace and work angian mechanics THECOURSE OU member	envelope for the envelope for the sto solve destroyed (L2)	Blo Apply (L3)	types of ation of	ifferent ayors to perform to perform to perform to perform to perform the performance of	Evalua (L5)	1,2 1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
CO3 Apply the know task. CO5 Identify work robot. BLOOM'S LEVELOF CO Ren CO1 CO2 CO3 CO4 CO5 CO6	owledge of Lagra e plan of traject kspace and work angian mechanics THECOURSE OUT member Und (L1)	envelope for the envelope for the sto solve described (L2)	Blo Apply (L3)	types of ation of	ifferent ayors to perform frobots. planer an vel Analyze (L4)	Evalua (L5)	1,2 1,2 1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)
2. https://www.jair. SWAYAM/NPTEL/N 1. https://onlinecoul Course Title Course Code Course Code Course Structure COURSE OVERVIEW Robot Dynamics is r (kinematics) but also of basic robotic syst COURSE OBJECTIVE 1. To control both th 2. The relationship th 3. Planning trajector 4. To precisely controus COURSE OUTCOME After the completio CO CO1 Apply the tra objects in 3 of CO2 Understand I CO3 Apply the known CO4 Elaborate the task. CO5 Identify work Apply Langra robot. BLOOM'S LEVELOF CO Ren CO1 CO2 CO3 CO4 CO5 CO6 Ref: BOS/SME/BME-202	owledge of Lagra e plan of traject kspace and work angian mechanics THECOURSE OU member	envelope for the envelope for the sto solve destroyed (L2)	Blo Apply (L3)	types of ation of	ifferent ayors to perform to perf	Evalua (L5)	1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2	1,2 1,2 1,2 1,2 1,2 Create (L6)

			Bloom	's Level		
со	Remember	Understand	Apply	Analyze	Evaluate	Create
	(L1)	(L2)	(L3)	(L4)	(L5)	(L6)
CO1			√			
CO2		✓				
CO3			✓			
CO4			✓			
CO5			✓			
CO6			✓			

COURSE ARTICULATION MATRIX

CO/ POs	PO1	P02	PO3	P04	PO5	P06	PO7	P08	P09	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3	2											3	1	
CO2	3	2											3	1	
CO3	2	3											2	3	
CO4	2	3											2	3	
CO5	3	2											3	1	
CO6	2	3											2	3	
Average	2.5	2.5											2.5	2	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Position and orientation of objects, objects coordinate frame Rotation matrix, Euler angles Roll, pitch and yaw angles coordinate Transformations, Joint variables and position of end effector, Dot and cross products, coordinate frames, Rotations, Homogeneous coordinates.

Unit-2

Manipulator Dynamics: Introduction, Lagrange's equation kinetic and potential energy. Link inertia Tensor, link Jacobian Manipulator inertia tensor. Gravity, Generalized forces, Lagrange-Euler Dynamic model, Dynamic model of a Two-axis planar robot, Newton Euler formulation, Lagrange - Euler formulation, problems.

Unit-3

Work Space Analysis and Trajectory Planning: Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique - continuous path motion, Interpolated motion, straight line motion and Cartesian space technique in trajectory planning.

Unit-4

Introduction to Motion Control: Introduction, Langrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar and articulated robot.

TEXT BOOKS

- 1. Schilling, Robert J. "Fundamentals of Robotics: Analysis and Control". Simon & Schuster Trade, 1996.
- 2. Niku, Saeed B. "Introduction to Robotics: Analysis, Systems, Applications". Vol. 7. New Jersey: Prentice hall, 2001.

REFERENCE BOOKS

- 1. Craig, John J. "Introduction to Robotics: Mechanics and Control". Pearson Education, 2005.
- 2. Deb, Satya Ranjan, and Sankha Deb. "Robotics Technology and Flexible Automation". McGraw-Hill Education, 2010.
- 3. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
- 4. Saha S K, "Introduction to Robotics", Tata McGraw Hill Education Pvt. Ltd, 2010.

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/journal/robotics-and-autonomous-systems
- 2. https://www.sciencedirect.com/journal/robotics

Course Title	Comput	ational Fluid	Dynamic	cs	Cours	se Type	Soft	Core
Course Code	B20ERS713	Credits		3	С	Class		mester
	TLP	Credits	Contact	Work	Total Number of Classes Assessn		mont in	
	I LF	Credits	Hours	Load				ghtage
Course	Theory	3	3	3	Per Se	emester	vvei	giitage
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

СО	Course Outcomes	POs	PSOs
L (*(*)1	Gain the fundamental Knowledge of computational fluid dynamics and describe boundary conditions and numerical errors.	1	1,2
CO2	Derive the governing equations related to CFD applications.	1,2	1,2
CO3	Analyze the fluid flow fields using discretization techniques.	1,2	1,2
CO4	Apply turbulence models for fluid flow analysis over immersed bodies.	1,2,3,4,5,6	1,2
L CO5	Demonstrate the procedure used for analyzing fluid flow characteristics	1,2,3,4,5,6,9	1,2,3
	performance using CFD tool.		
CO6	Solve real-world applications related fluid flow analysis using CFD tools.	1,2,3,4,5	1,2,3

SWAYAM/NPTEL	./MOOCs:										
1. https://onlined	courses.nptel	l.ac.in/noc21_m	e76/previev	V							
Course Title	Co	omputational Fl	uid Dynami	cs	Cours	е Туре	Soft C	Core			
Course Code	B20ER	S713 Credit	S	3	C	ass	VII sem	ester			
	TLF	Credit	S Contact Hours	Work Load	Total N Cla	umber of isses	Assessm Weigh	ent in tage			
Course	Pract	ory 3	3	3	Per Se	emester					
Structure	Tutor	rial 0	0	0	Theory	Practical	IA	SEE			
	Tota	al 3	3	3	39	0	50 %	50 %			
COURSE OVERVII	EW	L	l	<u>I</u>		<u> </u>					
SWAYAM/NPTEL 1. https://onlined Course Title Course Code Course Code Course Structure COURSE OVERVII This course deals equations using modelling, discree COURSE OBJECTI 1. To acquire the governing equality of the govern	basic knowled students we ations of flui students to stechniques, streal-world arious numer MES (COs) tion of the conditions are governing energiate the produce using CFE-world applic DF THECOUR	edge of concepts ith sufficient ba d flow and heat olve the probler skills, & enginee fluid-flow proble ical techniques ourse, the stude Course Knowledge of ond numerical end quations related fields using discretels for fluid flow ocedure used o tool. ations related flost	s of Comput ckground to transfer app m using the ring tools ne ems, in formulation nt will be ab e Outcomes computation rors. d to CFD app retization ter analysis ove for analyz	ational fl underst plications discretiza cessary f ng a num le to: lications chniques er immer ing fluic	dynamics sed bodies flow cl	nics. nathematical nique. ering practice tion method and describe s. naracteristics	representa by applying POs 1 1,2 1,2 1,2,3,4,5,6 1,2,3,4,5,6,6	PSOs 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2			
			BI	oom's Le	vel						
CO R	Remember	Understand	Apply		Analyze	Evalua	te (Create			
601	(LI)	(L2) ./	(L3)		(L4)	(L5)		(LO)			
(.())		v			√	+					
CO2					· ✓						
CO1 CO2 CO3			_/		•						
CO2 CO3 CO4	CO4										
CO2 CO3 CO4 CO5		CO5									
CO2 CO3 CO4 CO5 CO6											

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	P04	PO5	P06	P07	P08	P09	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3	2											3	2	
CO2	3	3	1	1									3	2	
CO3	3	3	1	1									3	2	
CO4	3	3	1	1									3	2	
CO5	3	3	1	1	2				1				3	2	2
CO6	3	3	1	1	2				1				3	2	2
Average	3	2.83	1	1	2				1				3	2	2

Note: 1-Low, 2-Medium, 3-High

Unit-1

Introduction and Basic Governing Equations: Introduction to CFD, advantages, Limitations of CFD, applications of CFD in different fields, the future of computational fluid dynamics, Different forces acting on the fluid, Governing equations of fluid dynamics-Continuity, Momentum and energy equations in differential form, Boundary conditions-Neumann, and Dirichlet, Numerical errors -.truncation error, round off error, Discretization error.

Unit-2

CFD Techniques: Basic aspects of discretization, Discretization techniques- Finite Element Method, Finite difference method and Finite volume method, Comparison of discretization by the three methods - three-dimensional continuity equation in Cartesian coordinates, Introduction to Finite differences- – Explicit, Implicit and Crank-Nicolson methods, Stability criterion.

Unit-3

Simulation Techniques: Important features of turbulent flow, Reynolds average Navier Stokes (RANS) equation, Necessity of turbulence modeling, Different types of turbulence model: discussion on - Turbulent kinetic energy and dissipation, one equation- Spalart-Allmaras, two-equation model: κ - ϵ model, Advantages and disadvantages, RNG κ - ϵ model and κ - ω model, Multiphase flow.

Unit-4

Application of CFD: Geometry creation, meshing, grid-independent test, mesh refinement analysis, practical boundary condition, validation, and results. Convergence, accuracy, Discussion on Advanced topics in CFD - Virtual reality meets, Fluid structure interaction, Physiological Fluid Dynamics, Discussion on Practical problems using CFD tools.

CASE STUDIES

- 1. Analysis of Laminar Flow through Pipe
- 2. Analysis of orifice meter
- 3. Analysis of Fluid Flow over a Car.
- 4. A Numerical Investigation of the Incompressible Flow through a Butterfly Valve Using CFD
- 5. Explain briefly how to simulate a NACA 0012 Airfoil at a 6 degree angle of attack placed in a wind tunnel, using FLUENT.
- 6. Study of Flow around a Rotating Cylinder

TEXT BOOKS

- 1. J. D Anderson, "Fundamental of Computational fluid dynamics", McGraw-Hill Publications, 6th Edition, 2017.
- 2. Jiyuan Tu "Computational Fluid Dynamics A practical approach", Butterworth Heinemann, 3rd Edition, 2018.

REFERENCE BOOKS

- 1. K. Muralidhar, T. Sundarajan "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2nd Edition, 2003.
- 2. Suhas V Patankar, "Numerical Heat Transfer and Fluid Flow", CRC Press, 1st Edition, 2018.

JOURNALS/MAGAZINES

- 1. International Journal of Computational Fluid Dynamics, Taylor and Francis.
- 2. Progress in Computational Fluid Dynamics, An International Journal, Inderscience Publishers.

Course Title	Micro Elec	tro Mechan	ical Syste	ms	Cours	se Type	Sof	t Core
Course Code	B20ERS714	Credits	3	3	С	Class		mester
	TLP	Credits	Contact	Work	Total Number of		sment in	
	ILF	Credits	Hours	Load	Cla	Classes		ghtage
Course	Theory	3	3	3	Per Se	emester	vvei	giitage
Structure	Practice	0	0	0	Thooma	Practical	10	SEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

co	Course Outcomes	POs	PSOs
CO1	Recognize MEMS and Microsystems applications in engineering	1	1,2
CO2	Explain the working of micro devices, micro systems and their applications.	1	1,2
CO3	Explain the fabrication techniques used to develop micro electro mechanical systems.	1,5	1,2
CO4	Apply material science principles to sensor design.	1	1,2
CO5	Identify the materials utilized in sensor designs.	1	1,2
CO6	Develop micro devices and microsystems by conceptualizing and designing them.	1, 3	1,2,3

SWAYAM/NPTEL/MOOCS: 1. Computational Fluid Dynamics, by Prof. Suman Chakraborty, IIT Kharagpu (https://onlinecourses.npte.ac.in/noc21_me126/preview) 2. Foundation of Computational Fluid Dynamics, by Prof. Vengadesan, IIT Madras Course Title													
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Course Title	(https://onlineco	urses.nptel.a	ac.in/noc21 m	e126/previ	<u>ew</u>)								
Course Title Micro Electro Mechanical Systems Course Type Soft Core Course Code B20ER5714 Credits Contact Work Total Number of Classes TLP Credits Hours Load Classes Theory 3 3 3 3 7 Per Semester Per Semester Practice 0 0 0 0 Theory Practical IA SEE Total 3 3 3 3 9 0 50 50 % 50 % Course Trutorial 0 0 0 0 Theory Practical IA SEE Total 3 3 3 3 3 9 0 50 % 50 % COURSE OVERVIEW This course explores the field of micro electro mechanical systems (MEMS). This necessitates an understanding of the design, manufacturing, and materials concerns associated with microsystems. The course will cover fabrication technologies, material properties, basic sensing and actuation principles and MEMS applications. The course will emphasize the fabrication and materials of microsystems. COURSE OBJECTIVES 1. Understand the fundamentals of micro manufacturing methods. 2. Recognize and connect the different sensors and actuators to applications. 3. Identify the materials used in MEMS. 4. Analyze the materials used in MEMS. 5. To develop MEMS applications for several fields COURSE OBJECTIVES COURSE OUTCOMES (COS) After the completion of the course, the student will be able to: CO Course Outcomes POs PSOs CO1 Recognize MEMS and Microsystems applications in engineering 1 1,2 CO3 Explain the fabrication techniques used to develop micro electro mechanical 1,5 CO4 Explain the working of micro devices, micro systems and their applications. 1 1,2 CO5 Mentify the materials utilized in sensor designs. 1 1,2 CO6 Develop micro devices and microsystems by conceptualizing and designing them. 1, 3 1,2,3 CO7 CO7 CO7 V V V V CO8 CO7 CO7 V V V CO8 CO7	2. Foundation of Co	mputational	Fluid Dynamic	s, by Prof. \	engade:	san, IIT Ma	adras						
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(L1) (L2) (L3) (L4) (L5) (L6)	CO Rem	nember	Understand	Apply		Analyze	Evalua	te	Create				
CO1 ✓ CO2 ✓ CO3 ✓ CO4 ✓ CO5 ✓ CO6 ✓ Ref: BOS/SME/BME-2020-21-20.06.20/2021-22-05.06.21/2022-23-25.06.22/2023-24-10.06.23	1	(L1)	(L2)	(L3)		(L4)	(L5)		(L6)				
CO2			✓										
CO3	CO1		✓										
CO4	CO1 CO2	CO3 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \											
CO5	CO1 CO2 CO3		CO4 \										
CO6	CO1 CO2 CO3 CO4		ļ		CO5								
Ref: BOS/SME/BME-2020-21-20.06.20/2021-22-05.06.21/2022-23-25.06.22/2023-24-10.06.23	CO1 CO2 CO3 CO4 CO5		√					1					
Ref: BOS/SME/BME-2020-21-20.06.20/2021-22-05.06.21/2022-23-25.06.22/2023-24-10.06.23	CO1 CO2 CO3 CO4 CO5		√ √										
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COURSE ARTICULATIONMATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	90d	PO7	PO8	60d	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3												3	1	
CO2	3												3	1	
CO3	3				1								3	1	
CO4	1												3	1	
CO5	3												3	1	
CO6	3		1										3	1	3
Average	2.67		1										3	1	3

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Overview of MEMS and Microsystems: MEMS & Microsystems, typical products, Evolution, Microsystems and microelectronics, Multidisciplinary nature, Microsystems and miniaturization, Applications of Microsystems in automobile and other industry.

Working Principle of Microsystems: Biomedical and biosensors. Micro sensors: Acoustic, Chemical, Optical, Pressure, Thermal.

Unit-2

Materials for MEMS and Microsystems: Structure of silicon and other materials, Silicon wafer processing -Bulk micromachining and Surface micromachining, Wafer-bonding. Thin-film deposition, Lithography, wet etching and dry etching.

Unit-3

Micro Actuation: Using thermal forces, shape memory alloys, piezoelectric crystals and electrostatic forces. **MEMS with Micro Actuators:** Microgrippers, micromotors, microvalves and micropumps, micro accelerometers, microfluidics.

Introduction to Scaling: Scaling in Geometry, Scaling in Rigid body dynamics, Scaling in Electrostatic forces, scaling in electromagnetic forces and scaling in fluid mechanics.

Unit-4

Microsystem Fabrication Process: Introduction to microsystems, Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PVD-Sputtering, Deposition of Epitaxy, Etching, LIGA process: General description, Materials for substrates and photoresists, Electroplating and SLIGA process.

CASE STUDIES

- 1. Commercial MEMS Case Studies: The Impact of Materials, Processes and Designs.
- 2. Fabrication of MEMS devices a scanning micro mirror case study- principle, design, and fabrication of a silicon-based scanning micromirror with a new type of action mechanism as an example of MEMS.
- 3. MEMS Manufacturing Testing: An Accelerometer Case Study
- 4. Introduction to Applications and Industries for Microelectromechanical Systems (MEMS) MEMS fabricated combustible gas sensor.

TEXT BOOKS

- 1. Tai-Ran Hsu, "MEMS & Microsystems Design and Manufacture", Tata McGraw Hill Education, 2nd Edition, New Delhi. 2002
- 2. Chang Liu," Foundations of MEMS", Pearson Education Inc., 2012.

REFERENCE BOOKS

- 1. Vijay K Varadan, K. J. Vinoy, S. Gopalakrishnan, "Smart Material Systems and MEMS", Wiley, 2015.
- 2. The MEMS Handbook, Mohamed Gad-el-Hak, Taylor and Francis Publication, 2006.
- 3. James J Allen, "MEMS Design", Taylor and Francis Publication, 1st Edition, 2005.

Course Title	Total Quality N	/lanagement	and Six S	Sigma	Cour	se Type	Soft	Core
Course Code	B20ERS715	Credits	:	3	С	Class		mester
	TLP	Credits	Contact	Work	Total Number of		٨٥٥٥٥	sment in
	ILF	Credits	Hours	Load	Cla	Classes		
Course	Theory	3	3/	3	Per Se	emester	Weightage	
Structure	Practice	0	0	0	Thoomi	Practical	10	CEE
	Tutorial	0 ^	0	0 \	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

JOURNALS/MAG	GAZINES							
1. https://www.j	ournals.elsevier.co	m/micro-and	d-nano-en	gineerin	g ,			
2. https://www.s	ciencedirect.com/	topics/nursir	ng-and-hea	alth-proi	ressions/m	icroelectror	nechanica	ıl-system
SMAVAM/NIDTE	/MOOCs:							
1. https://nptel.a	c.in/courses/1171	05082						
2. https://nptel.a	c.in/courses/1081	06165/						
Course Title	Total Quality	Managemen	t and Six S	Sigma	Cours	е Туре	Sof	t Core
Course Code	B20ERS715	Credits	3	3	С	ass	VII s	emester
	TIP	Credits	Contact	Work	Total N	umber of	Αςςρα	sment in
	7.2.	2. 24.15	Hours	Load	Cla	isses	We	ightage
Course	Theory	3	3	3	Per Se	emester		_ <u> </u>
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
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COLUMN CALCALLA	Total	3/	3	3	39	U	50 %	50 %
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		Bloom's Level									
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)					
CO1			✓								
CO2			✓								

CO3			✓	
CO4		√		
CO5		✓		
CO6			√	

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	P02	PO3	PO4	PO5	90d	PO7	80d	60d	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	2	1										3	1	1
CO2	3	2	1										3	1	1
CO3	3	3			1								3	1	1
CO4	3	1			1								3	1	1
CO5	3	2	1		1								3	1	1
CO6	3	3	1										3	1	1
Average	3	2.2	1		1	,							3	1	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Principles and Practices: Basic approach, gurus of TQM, TQM frame work, awareness, defining quality, historical review, obstacles, benefits of TQM.

Leadership: Definition, characteristics of quality leaders, leadership concepts, Deming philosophy, role of TQM leaders, implementation, strategic planning communication

Unit-2

Customer Satisfaction and Customer Involvement: Perception of quality, feedback using customer complaints, service quality, translating needs into Requirements, Kano model, customer retention. Employee involvement - Motivation, employee surveys, Empowerment teams, suggestion system, recognition and reward, gain sharing, performance appraisal

Unit-3

Continuous Process Improvement: Juran triology, improvement strategies, PDCA cycle, problem solving methods, Kaizen, 5S concepts, six sigma. Tool and Techniques - Statistical process control-7QC tools, Benching marking, information technology, quality management systems, QFD, FMEA, product liability, Total productive maintenance. TQMEX model.

Unit-4

Quality Management Tools: Forced filed analysis, nominal group techniques, affinity diagram, interrelationship digraph, tree diagram, matrix diagram, process decision program chart and activity network diagram.

Design for Six Sigma: Introduction to DMAIC approach and DFSS, tools for concept development, design development, design optimization and design verification problems.

CASE STUDIES

- 1. Implementation of Total Quality management for an automobile industry.
- 2. Gillette's TQM Successfully Story
- 3. Implementation of Six Sigma A successful journey in various firm.
- 4. Generic Electrics Six -Sigma Journey

Note: Student can do certification course on 6σ -yellow belt

TEXT BOOKS

- 1. Dale H.Bester field, "Total quality Management", Pearson Education India, 5 Edition, 2019.
- 2. M.Zairi, "Total quality Management for Engineers", McGraw-Hill's, 3rd Edition, 1991.

REFERENCE BOOKS

1. Shoji shiba, Aln Graham, David Walden, "A new American TQM, four revolutions in Management",

Productivity Press, Orgeon, 1990.

- 2. Gopal K.Kanji and Mike Asher, "100 Methods for TQM", Sage Publications, Inc., 1st Edition.
- 3. H.Lal, "Organizational Excellence through TQM" New age Publication.
- 4. Poornima M Charanth, Total Quality Management, Pearson Publication, 4th Edition, 2022.

JOURNALS/MAGAZINES

1. https://www.emerald.com/insight/publication/issn/0265-671X - International journal of quality and Reliability Management

2. https://www.emerald.com/insight/publication/issn/2040-4166---- internal journal of six sigma

SWAYAM/NPTEL/MOOCs:

- 1. https://onlinecourses.nptel.ac.in/noc21_mg03/preview
- 2. https://nptel.ac.in/courses/110104085

Course Title	In	ternship Pha	se-1		Cour	se Type	Sof	t core	
Course Code	B20ERS716	Credits	/ :	3	С	lass	VII se	mester	
	TLP	TLP Credits H		Work Load		umber of asses	Assessment in		
Course	Theory	/0	0	/ 0	Per Se	emester	wei	ghtage	
Structure	Practice	3	/3/	3	Theory	Practical	IA	SEE	
	Tutorial	0	0	(0	Hieory	Fractical	IA	JLL	
	Total	3	3	3	0 /	39	50 %	50 %	

COURSE OVERVIEW

The internship in field of study is essential to successful outcomes after graduation. Classroom environment may involve only with discussion, debate, peer interaction, and shared learning experiences. But it is important to seek opportunities for a student to apply academic concepts according to industrial requirements.

COURSE OBJECTIVES

1. To gain a practice-oriented and 'hands-on' working experience in the real world and to enhance the student's learning experience.

- 2. To develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in real organizational setting.
- 3. To enhance operational, customer service, life-long knowledge and skills in a real world work environment.
- 4. To get pre-employment training opportunities and an opportunity for the company or organization to assess the performance of the student and to offer an employment opportunity after his/her graduation, if it deems fit.

.COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

co	Course Outcomes	POs	PSOs
CO1	Solve real life challenges in the workplace by analyzing work environment and	1, 2	1, 2
1001	conditions, and selecting appropriate skill sets acquired from the course.	1, 2	1, 2
CO2	Demonstrate the application of knowledge and skill sets acquired from the course and	1,2,3	1, 2
	workplace in the assigned job functions.		
CO3	Articulate career options by considering opportunities in company, sector, industry,	1 2 5 6	1, 2
603	professional and educational advancement.	1, 2, 3, 0	
1 (() /)	, , , , ,	9, 10, 11,	1, 2
004	professionals in the work environment through written and oral means.	12	
CO5	Exhibit critical thinking and problem solving skills by analyzing underlying issue/s to	1, 2, 3,4	1, 2, 3
COS	challenges.	1, 2, 3,4	
CO6	Exhibit professional ethics by displaying positive disposition during internship	7,8	1

BLOOM'S LEVELOF THECOURSE OUTCOMES CO Remember Understand Apply Analyze Evaluate Create	BLOOM'S LEVE	LOF 1	THEC	OURSE	E OUTC	OMES										
CO Remember Understand Apply (L3) (L4) (L5) (L6) (L6)							1	Blo	oom's	Level				1		
CO1 CO2 CO3 CO4 CO5 CO5 CO6 CO5 CO6 CO7 CO7 CO7 CO8 CO7 CO8 CO8 CO9 CO8 CO8 CO9 CO8 CO9	СО	Rem	nemb (L1)	er	Under	rstand		Apply		Anal	yze •\	Ev	/aluate	·	Crea	te \
CO2	CO1	((L1)		(L	2)		(L3)		(L ²	,		(L5)		(Lb)
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CO4 CO5 CO6 CO6 COCURSE ARTICULATIONMATRIX CO / POS CO1 S CO1 S S CO2 S S CO3 S S CO3 S S S CO2 S S S CO3 S S S S S S S S S S S S S S S S S S S	CO2										,					
COS COURSE ARTICULATIONMATRIX CO/ POS DO	CO4										,					
COURSE CONTENT Student who will get opportunity to undergo paid internship during 7th semester is permitted to register for internship pahse-1 course. Student should prepare a comprehensive report to indicate what he/she has observed and learnt in the training period. The student may contact Faculty Mentor taking guidance on how to make presentation and preparation of report. Student should prepare the final report on internship topic. The Internship report will be evaluated on the basis of following criteria: 1. Originality. 11. Adequacy and purposeful write-up. 111. Organization, format, drawings, sketches, style, language etc. 11. V. Variety and relevance of learning experience. 12. V. Practical applications, relationships with basic theory and concepts taught in the course. Evaluation through Seminar Presentation, Assignments/Case Studies /Simulation and Viva-Voce: The student expected to give a seminar / presentation and submit of case studies / assignment/ simulation whichever the faculty mentor expect. 12. Submission of Assignment/Case Studies/Simulation Solution relevance to Internship completed. 13. U. Quality of content presented. 14. Proper planning for presentation. 15. U. Submission of Assignment/Case Studies/Simulation Solution relevance to Internship completed. 16. U. Quality of content presentation. 17. Effectiveness of presentation. 18. U. Eppth of knowledge and skills. 19. V. Depth of knowledge and skills. 10. V. Depth of knowledge and skills.	CO5										,					
COURSE ARTICULATIONMATRIX CO/ Pos G R R R R R R R R R	CO6										,					
CO/ POS RO	COURSE ARTICI	Ι ΙΙ ΔΤ	TIONIN	MΔTRI	X											
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CO2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	CO1 3	3	3											3	3	
CO3 3 3 3 3	CO2 3	3	3	3										3	3	
CO4	CO3 3	3	3			3	3							3	3	
COS 3 3 3 1 1 3 3 2 2 2 3 3 3 2 2 2 3 3 3 2 2	CO4				_		`			3	3	2	2	3	3	_
Average 3 3 3 1 3 2 2 2 3 3 2 2 3 3 2 2 3 3 2 2 3 3 2 2 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 2 3 3 3 2 3 3 3 2 3	CO5 3	3	3	3	1/	/		/_						3	3	2
Note: 1-Low, 2-Medium, 3-High COURSE CONTENT Student who will get opportunity to undergo paid internship during 7th semester is permitted to register for internship pahse-1 course. Student should prepare a comprehensive report to indicate what he/she has observed and learnt in the training period. The student may contact Faculty Mentor taking guidance on how to make presentation and preparation of report. Student should prepare the final report on internship topic. The Internship report will be evaluated on the basis of following criteria: 1. Originality. 11. Adequacy and purposeful write-up. 111. Organization, format, drawings, sketches, style, language etc. 11. Variety and relevance of learning experience. 12. V. Practical applications, relationships with basic theory and concepts taught in the course. Evaluation through Seminar Presentation, Assignments/Case Studies / Simulation and Viva-Voce: The student expected to give a seminar / presentation and submit of case studies / assignment/ simulation whichever the faculty mentor expect. The evaluation will be based on the following criteria: 1. Submission of Assignment/Case Studies/Simulation Solution relevance to Internship completed. 11. Quality of content presentation. 12. Effectiveness of presentation. 13. U. Effectiveness of presentation. 14. V. Depth of knowledge and skills. 15. VI. Report Writing	CO6		2					/ 2	<2					3	3	
COURSE CONTENT Student who will get opportunity to undergo paid internship during 7th semester is permitted to register for internship pahse-1 course. Student should prepare a comprehensive report to indicate what he/she has observed and learnt in the training period. The student may contact Faculty Mentor taking guidance on how to make presentation and preparation of report. Student should prepare the final report on internship topic. The Internship report will be evaluated on the basis of following criteria: 1. Originality. 11. Adequacy and purposeful write-up. 111. Organization, format, drawings, sketches, style, language etc. 11. V. Variety and relevance of learning experience. 12. V. Practical applications, relationships with basic theory and concepts taught in the course. Evaluation through Seminar Presentation, Assignments/Case Studies / Simulation and Viva-Voce: The student expected to give a seminar / presentation and submit of case studies / assignment/ simulation whichever the faculty mentor expect. The evaluation will be based on the following criteria: 1. Submission of Assignment/Case Studies/Simulation Solution relevance to Internship completed. 11. Proper planning for presentation. 12. Effectiveness of presentation. 13. U. Depth of knowledge and skills. 14. VI. Report Writing TEXT BOOKS	Average 3	5	3	3			2/	_	3		1 3	_	2	_	_	_
Evaluation through Seminar Presentation, Assignments/Case Studies /Simulation and Viva-Voce: The student expected to give a seminar / presentation and submit of case studies / assignment/ simulation whichever the faculty mentor expect. The evaluation will be based on the following criteria: I. Submission of Assignment/Case Studies/Simulation Solution relevance to Internship completed. II. Quality of content presented. III. Proper planning for presentation. IV. Effectiveness of presentation. V. Depth of knowledge and skills. VI. Report Writing	COURSE CONTE Student who w	-Med ENT vill ge	dium,	3-High	nity to	underg	3 go paid	2 intern	ship d	uring 7	3 7 th sem	ester i	s perm	3	3 to regis	2 ster fo
	Student who w internship pahs observed and le make presentat The Internship I. Originalit II. Adequact III. Organizat IV. Variety at V. Practical	ENT vill ge se-1 ce earnt tion a ty. cy and and r l appl	dium, et opp course t in th and p ort will d purp n, forn releva	3-High portune. Stude train repara II be en posefunat, drance of ons, re	nity to dent spining peration of valuate rawings of learning lations	underg hould riod. T f reported on t -up. s, sketc ng exp hips w	o paid prepa he stud he bas hes, st erienc th bas	internate a codent ment showis of forward parts are in the code at	aship dompre ay con ould prollowin	uring 7 hensive tact Fa epare t g criter etc.	yth seme repoculty Mache fination	ester i rt to identor repo	s permindication taking rt on in	anitted to e what guidar atternsh	to regist he/s	2 ster fo he had how to c.

CO/ POs	PO1	PO2	PO3	PO4	PO5	90d	P07	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	3				/							3	3	
CO2	3	3	3										3	3	
CO3	3	3			3	3							3	3	
CO4									3	3	2	2	3	3	
CO5	3	3	3	1 /	/								3	3	2
CO6							/ 2	(2					3	3	
Average	3	3	3	1	3	3	2	2	3	3	2	2	3	3	2

Course Title	Fluid	Power Engir	neering		Cour	se Type	Soft	Core		
Course Code	B20ERS721	Credits	3	3	С	lass	VII se	mester		
	TLP	TLP Credits Contact \		Work	Total N	umber of	٨٠٠٥٠	mont in		
	ILF	Credits	Hours Load		Cla	asses	Assessment in Weightage			
Course	Theory	3	3	3	Per Se	emester	vvei	giitage		
Structure	Practice	0	0	0	Thoony	Practical	IA	SEE		
	Tutorial	0	0	0	Theory	Practical	IA	SEE		
	Total	3	3	3	39	0	50 %	50 %		

СО	Course Outcomes	POs	PSOs
CO1	Apply the concept of Pascal's law for designing of fluid power devices.	1,2	1,2
+ CO2	Identify and select the hydraulic and pneumatic components for the various applications	1,2	1,2
1 (() \	Design the hydraulic, pneumatic power circuits for the given applications and simulate using fluidSIM software.	1,2,3,5	1,2
CO4	Identify and select the suitable fluids for the fluid power applications.	1,2	1,2
CO5	Analyze the performance of fluid power components.	1,2	1,2
CO6	Use PLCs for controlling of fluid power devices.	1,2	1,2

Course Title Fluid Power Engineering Course Type Soft Core Course Code B20R5721 Credits Society Course Code Co	Course Code	"		ngino	ering		4	Cours	e Type		Safe	t Core	
Course Theory 3 3 3 3 3 Personal Number of Classes Structure Practice 0 0 0 0 Theory Practical IA SEE Tutorial 0 0 0 0 Theory Practical IA SEE Tutorial 0 0 0 0 Theory Practical IA SEE Tutorial 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 0 Theory Practical IA SEE Tutorial 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Course Cour	B20FRS72	1 Credi	te	:ering	2	+ '	Cours	acc	+	ا ۱۱۷	meste	r
Theory 3 3 3 3 Per Semester Practice O O O O Theory Practical IA SEE		TLP	Credi	ts C	Contact	Work	То	tal N	umber of	<i>A</i>	Assess	sment i	n
Structure	Course	Theory	3		2	2	_ ا	Cia Opr Sa	mastar		Wei	ghtage	
Tutorial 0 0 0 0 Theory Practical IA SEE Tutorial 1 3 3 3 3 3 9 0 50 50 % 50 % COURSE OVERVIEW Total 3 3 3 3 3 9 0 50 50 % 50 % The Fluid Power Engineering course is designed to equip delegates with the basic foundation knowledge arbuilding blocks that underpin all hydraulic pneumatic systems. This course deals with the basic components are functions of hydraulic and pneumatic systems. Fluid power has the highest power density of all convention power-transmission technologies. Learn the benefits and limitations of fluid power, analyze fluid power components and circuits, and design and simulate fluid power circuits for applications. Topics include standa symbols, pumps, control valves, control assemblies, actuators, maintenance procedures, and switching are control devices. COURSE OBJECTIVES 1. To attain the knowledge of hydraulic and pneumatic systems. 2. To familiar with the power transmission in hydraulic cylinders and motors and solve the Problems. 3. To impart the knowledge or controlling components of hydraulics and pneumatics systems. 4. To understand the hydraulic and pneumatic circuits and interpret their applications. COURSE OUTCOMES (COS) After the completion of the course, the student will be able to: CO Course Outcomes COI Apply the concept of Pascal's law for designing of fluid power devices. COI Apply the concept of Pascal's law for designing of fluid power devices. COI Apply the concept of Pascal's law for designing of fluid power devices. COI Apply the concept of Pascal's law for designing of fluid power devices. COI Apply the concept of Pascal's law for designing of fluid power devices. COI Apply the performance of fluid power devices. COI Apply the performance of fluid power devices. COI Besign the hydraulic pneumatic power components. COS Analyze the performance of fluid power devices. 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,3 1,2 1,2 1,4 1,2 1,2 1,5 1,2 1,2 1,5 1,2 1,2 1,6 1,2 1,2 1,2 1,7 1,2 1,2 1,2 1,2 1,2 1,2 1,2 1,3 1,2 1,2 1,2 1,4	Structure	Practice	0		0	0	'	C1 3C	inester				
Total 3 3 3 3 9 0 50 % 50 % COURSE OVERVIEW The Fluid Power Engineering course is designed to equip delegates with the basic foundation knowledge arbuilding blocks that underpin all hydraulic pneumatic systems. This course deals with the basic components are functions of hydraulic and pneumatic systems. Fluid power has the highest power density of all convention power-transmission technologies. Learn the benefits and limitations of fluid power, analyze fluid power components and circuits, and design and simulate fluid power circuits for applications. Topics include standa symbols, pumps, control valves, control assemblies, actuators, maintenance procedures, and switching are control devices. COURSE OBJECTIVES 1. To attain the knowledge of hydraulic and pneumatic systems. 2. To familiar with the power transmission in hydraulic cylinders and motors and solve the Problems. 3. To impart the knowledge on controlling components of hydraulics and pneumatics systems. 4. To understand the hydraulic and pneumatic circuits and interpret their applications. COURSE OUTCOMES (COS) After the completion of the course, the student will be able to: CO Course Outcomes Pos Pos Pos Pos Pos Course Outcomes Pos Pos Pos Pos Pos Pos Pos Pos Pos Po	Structure	Tutorial	0		0	0	The	eory	Practical	L	A	SE	E
COURSE OVERVIEW The Fluid Power Engineering course is designed to equip delegates with the basic foundation knowledge are building blocks that underpin all hydraulic pneumatic systems. This course deals with the basic components are functions of hydraulic and pneumatic systems. Fluid power has the highest power density of all convention power-transmission technologies. Learn the benefits and limitations of fluid power, analyze fluid power components and circuits, and design and simulate fluid power circuits for applications. Topics include standa symbols, pumps, control valves, control assemblies, actuators, maintenance procedures, and switching are control devices. COURSE OBJECTIVES 1. To attain the knowledge of hydraulic and pneumatic systems. 2. To familiar with the power transmission in hydraulic cylinders and motors and solve the Problems. 3. To impart the knowledge on controlling components of hydraulics and pneumatics systems. 4. To understand the hydraulic and pneumatic circuits and interpret their applications. COURSE OUTCOMES (COS) After the completion of the course, the student will be able to: CO		Total	3		3	3	3	9	0	50	%	50	%
The Fluid Power Engineering course is designed to equip delegates with the basic foundation knowledge arbuilding blocks that underpin all hydraulic pneumatic systems. This course deals with the basic components are functions of hydraulic and pneumatic systems. Fluid power has the highest power density of all conventions or power-transmission technologies. Learn the benefits and limitations of fluid power, analyze fluid power components and circuits, and design and simulate fluid power circuits for applications. Topics include standa symbols, pumps, control valves, control assemblies, actuators, maintenance procedures, and switching are control devices. COURSE OBJECTIVES 1. To attain the knowledge of hydraulic and pneumatic systems. 2. To familiar with the power transmission in hydraulic cylinders and motors and solve the Problems. 3. To impart the knowledge on controlling components of hydraulics and pneumatics systems. 4. To understand the hydraulic and pneumatic circuits and interpret their applications. COURSE OUTCOMES (COs) After the completion of the course, the student will be able to: CO	COURSE OVERVIEN	N								1 33			
Bloom's Level CO Remember Understand Apply Analyze Evaluate Create (L1) (L2) (L3) (L4) (L5) (L6) (L6) (C01	building blocks that functions of hydra power-transmission components and components of the second co	t underpin all ulic and pneum n technologie ircuits, and decontrol valves, ES owledge of hydraulic and the hydraulic and ES (COs) on of the course oncept of Pasc d select the last hydraulic, pning fluidSIM so I select the suit performance r controlling or	matic systemes. Learn the sign and sime control assumed and present and present aliance of the student and present aliance are control assumed and present aliance are controlling and present aliance are controlling are con	ms. Flue bennulate sembli oneum hydra omponic circulate design and professor circulate for the record revice device record recor	tic systematic systema	ems. There has and limit ower circulators, stems. inders a hydraud interpolation for the lower and sts.	is coult the high tation reuits from maint and molics are the onent given	otors	eals with the power defluid po	the Proystems	oblem 5. 1,2 1,2 1,2 1,2 1,2	pponen conven fluid ; ude sta witchin ns.	SOs ,,2 ,,2 ,,2 ,,2 ,,2
CO Remember (L1) (L2) (L3) (L4) (L5) (L5) (Ceate (L6) (L6) (L6) (L6) (L6) (L6) (L6) (L6)	3LOOM'S LEVELOR	- THECOURSE	OUTCOMES	$\overline{}$	/ DL	nom's l	ovol						
(L1)	CO Re	member I	Jnderstand		Apply	20111 3 E	Anal	vze	Fval	uate		Creat	<u> </u>
CO1		(L1)	(L2)		(L3)		(L4	1)	(L	.5)		(L6)	
CO2	CO1		-		√		-		1		1	<u> </u>	
CO3 CO4 CO5 CO5 CO6 CO6 COPOS CO/POS CO/POS CO1 CO1 CO1 CO2 CO3 CO3 CO3 CO3 CO4 CO5 CO6 CO6 CO6 CO7 CO6 CO7 CO6 CO7	CO2		√								+		
CO4	CO3						√	,			\dagger		
COS	CO4		√								\dagger		
CO/ POS	CO5								 	/	+		
COURSE ARTICULATIONMATRIX CO/ POS	CO6		√								+		
CO/ POs T </td <td>COURSE ARTICULA</td> <td>ATIONMATRIX</td> <td>•</td> <td></td>	COURSE ARTICULA	ATIONMATRIX	•										
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CO2 3 3 1 CO3 3 3 1	CO1 3	3			<u> </u>	_		_	 		3	1	_
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	CO3 3	3 1	1								3	1	

CO/ POs	PO1	P02	PO3	PO4	PO5	90d	PO7	PO8	P09	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	3											3	1	
CO2	3	3											3	1	
CO3	3	3	1		1								3	1	

CO4	3	2						3	1	
CO5	3	2						3	1	
CO6	3	2						3	1	
Average	3	2.5	1	1				3	1	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction to Fluid Power: Pascal's law, Applications of Pascal's Law, Basics of Hydraulics, Structure of Hydraulic System- Numerical on Pascal's law. Advantages and Disadvantages of fluid power, Application of fluid power system

Hydraulic Pumps: Pumping theory, Gear pump, Vane Pump, Piston pump, construction and working of pumps, pump performance, Factors for selection of pumps, Numerical on calculation of volumetric displacements, eccentricity and efficiencies of hydraulic pumps.

Unit-2

Control Valves and Fluid Power Actuators: Control Valves-DCV: Check valve, 3/2, 4/3, 5/3, 5/2, Solenoid operated DCV working, PRV: Pressure regulating and reducing valve, FCV: needle valve, Linear hydraulic actuators, Types of hydraulic cylinders, Single acting, Double acting, Special types of cylinders, Loading Mechanism, Cylinder Mounting, Cylinder load, speed and power, numerical.

Rotary Actuators: construction and working of motors, External Gear motor, Vane motor, Piston motor, Applications of Hydraulics Motors, Hydraulic motor performance, Numerical.

(Init-3

Hydraulic Circuits: Fluid Power Symbols, Single acting, Double acting, Regenerative, Double pump, Sequencing, Cylinder locking, Synchronizing, pump unloading circuit, counter balance circuit, Meter-in, Meter-out, Accumulators and Applications of Accumulators using circuits.

Demonstration: Hydraulics circuit design, simulation using FluidSIM software,

Maintenance of hydraulic Systems: Hydraulic oils, Desirable properties, Sealing Devices, Reservoirs System, Filters and strainers, Beta Ratio in filters, Problem caused by Gases in Hydraulic Fluids, Wear of moving parts to solid particle contamination, Temperature control, Trouble shooting.

Unit-4

Pneumatic Systems and Components: Pneumatic Components: Properties of air, types of Compressors, Filter, Regulator, and Lubricator Unit, Air control valves, Quick exhaust valves, and pneumatic actuators. Servo systems, Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics, Introduction to fluidic devices, simple circuits, Introduction to programmable logic controllers (PLC), Applications of PLCs in Fluid power sectors, Pneumatic logic circuits by using OR & AND logic gates.

Demonstration: Pneumatics circuit design, simulation using FluidSIM software.

TEXT BOOKS

- 1. Anthony Esposito, "Fluid Power with Applications", Seventh Edition, Pearson Education, 2013.
- 2. Majumdar S.R, "Oil Hydraulics", Tata McGraw-Hill, New Delh, 2017

REFERENCE BOOKS

- 1. Majumdar S.R, "Pneumatic systems Principles and Maintenance", Tata McGraw Hill, New Delhi, 2017.
- 2. James R. Daines, Martha J. Daines, "Fluid Power: Hydraulics and Pneumatics", Goodheart-Willcox; 3rd Edition, 2021.
- 3. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 2nd Edition, 1982.

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/journal/procedia engineering.
- 2. https://link.springer.com/article/10.1631/jzus.A1500042

SWAYAM/NPTEL/MOOCs:

Course Title		Tribology			Cours	е Туре	Sof	Core
Course Code	B20ERS722	Credits	3	3	С	lass	VII Se	mester
	TLP	Credits	Contact	Work	Total N	umber of	Vecoci	sment in
	I LF	Hor		Load	Cla	isses		ghtage
Course	Theory	3	3	3	Per Se	emester	vvei	giitage
Structure	Practice	0	0	0	Thoony	Practical	1.0	SEE
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

СО	Course Outcomes	POs	PSOs
CO1	Study the properties of Oil seals, Gaskets industrial tribology.	1	1,2
CO2	Analyze the friction and wear behavior in interacting surfaces.	1,2	1,2
CO3	Apply the principles of lubrication in designing of bearings.	1,2,3	1,2
CO4	Analyze the pressure of fluid film and estimate the load carrying capacity of journal bearing.	1,2	1,2
CO5	Analyze and interpret the power loss due to friction in Journal bearing.	1,2,4	1,2
CO6	Study the Interatomic Interactions in nano scale lubricants using Atomic Force Microscope.	1	1,2

1. https://nptel. 2. https://nptel.	.ac.in/courses/ .ac.in/courses/	/ 112106300/ / 112105046/						
Course Title	е	Tribolog	SY		Cours	е Туре	Soft	Core
Course Cod	e B20ERS	Credits		3	Cl	ass	VII Ser	mester
	TLP	Credits	Contact Hours	Work Load	Total N Cla	umber of esses	Assessr Weig	ment in htage
Course	Ineo	ico 0	3	3	Per Se	emester		
Structure	Tutor	ial 0	0	0	Theory	Practical	IA	SEE
	Tota	al 3	3	3	39	0	50 %	50 %
COURSE OVERV	/IEW		1 -				/ 0	22.0
motions with de COURSE OBJEC 1. To introduce that are in re 2. To understar applications. 3. To recognize 4. To analyze th COURSE OUTCO After the comple CO CO1 Study the	eformation at of TIVES tribology as an elative motion. Ind the importation the need of luce mechanism of the control of the control of the control of the friction and eprinciples of the principles of the triction and eprinciples of the triction and the principles of the triction and the principles of the triction and tricking the triction and tricking the tricking tricking the tricking	important aspectance of friction a abrication in mac of pressure develourse, the student Course of Oil seals, Gasket d wear behavior lubrication in deaf fluid film and es	t in design In design	the proponents are fluid film le to: I tribologous surface earings.	ems. Action in percess of defined bearing in journa y. es. ying capac	esigning composes. I bearing.	POS 1 1,2 1,2,3 1,2	PSOs 1,2 1,2 1,2 1,2
CO2 Analyze of CO3 Apply the CO4 Analyze of bearing.	the pressure of				/			_
CO2 Analyze to CO3 Apply the CO4 bearing. CO5 Analyze to Co5 Analy	and interpret t	the power loss du	e to frictio	n in Jour	nal bearing	g. Atomic Force	1,2,4	1,2
CO2 Analyze to bearing. CO4 Analyze to bearing. CO5 Analyze to Study the Microsco	and interpret to the Interaction	he power loss du Interactions in	e to frictio nano scale	n in Jour	nal bearing ts using A	g. Atomic Force	1,2,4	1,2
CO2 Analyze of CO3 Apply the CO4 bearing. CO5 Analyze of CO6 Study the Microsco	and interpret to the Interpret to the Interatomic to the Interatomic to the Interpret to the Interpre	the power loss du Interactions in	e to frictio nano scale	n in Jour	nal bearing ts using A	g. Atomic Force	1,2,4	1,2
CO2 Analyze of CO3 Apply the CO4 bearing. CO5 Analyze of CO6 Study the Microsco	and interpret tell Interpret to the Interatomic ope.	the power loss du Interactions in SE OUTCOMES	nano scale	n in Journ lubrican	ts using A	g. Atomic Force	1,2,4	1,2
CO2 Analyze to bearing. CO4 Analyze to bearing. CO5 Analyze to Microsco	and interpret to enterpret to enterpret to enterpret to ppe. LOF THECOURS Remember	Interactions in SE OUTCOMES Understand	e to frictionano scale BI Apply	n in Journ lubrican	vel Analyze	g. Atomic Force	1,2,4 1	1,2 1,2 Create
CO2 Analyze of CO4 Analyze of CO5 Analyze of Microsco	and interpret to the Interatomic ope. LOF THECOURS Remember (L1)	Interactions in SE OUTCOMES Understand (L2)	e to frictionano scale BI Apply (L3)	n in Journ lubrican	ts using A vel Analyze (L4)	g. Atomic Force Evalua (L5)	1,2,4 1	1,2 1,2 Create (L6)
CO2 Analyze to bearing. CO4 Analyze to bearing. CO5 Analyze to bearing. CO6 Study the Microscope BLOOM'S LEVEL CO CO1	and interpret to enterpret to enterpret to ppe. LOF THECOURS Remember (L1)	Interactions in SE OUTCOMES Understand (L2)	e to frictionano scale BI Apply (L3)	n in Journ lubrican oom's Le	vel Analyze (L4)	g. Atomic Force Evalua (L5)	1,2,4 1 te	1,2 1,2 Create (L6)
CO2 Analyze of bearing. CO3 Apply the bearing. CO5 Analyze of Study the Microsco	and interpret to the Interatomic ope. LOF THECOURS Remember (L1)	Interactions in SE OUTCOMES Understand (L2) ✓	e to frictionano scale BI Apply (L3)	n in Journ lubrican	vel Analyze (L4)	g. Atomic Force Evalua (L5)	1,2,4 1	1,2 1,2 Create (L6)
CO2 Analyze to bearing. CO3 Apply the bearing. CO5 Analyze to bearing. CO6 Study the Microscope. CO0 CO1 CO2 CO3 CO3	and interpret to the Interatomic ope. LOF THECOURS Remember (L1)	Interactions in SE OUTCOMES Understand (L2) ✓	e to frictionano scale BI Apply (L3)	n in Journ lubrican	vel (L4)	g. Atomic Force Evalua (L5)	1,2,4 1	1,2 1,2 Create (L6)
CO2 Analyze to bearing. CO4 Analyze to bearing. CO5 Analyze to Microsco BLOOM'S LEVEL CO CO1 CO2 CO3 CO4	and interpret to the Interatomic ope. LOF THECOURS Remember (L1)	Interactions in SE OUTCOMES Understand (L2)	BI Apply (L3)	n in Journ lubrican	vel Analyze (L4)	Evalua (L5)	1,2,4 1	1,2 1,2 Create (L6)
CO2 Analyze to bearing. CO3 Apply the bearing. CO5 Analyze to bearing. CO6 Study the Microscope CO1 CO2 CO3 CO4 CO5 CO4 CO5	and interpret to enterpret to enterpret to enterpret to ppe. LOF THECOURS Remember (L1)	Interactions in SE OUTCOMES Understand (L2)	BI Apply (L3)	n in Journ lubrican	vel (L4)	Evalua (L5)	1,2,4 1	1,2 1,2 Create (L6)
1. https://nptel. 2. https://nptel. Course Title Course Cod Course Structure COURSE OVERY Tribology deals motion to achie the loads that lubrication will motions with de COURSE OBJEC 1. To introduce that are in ref. 2. To understar applications. 3. To recognize 4. To analyze th COURSE OUTCO After the comple CO CO1 Study the CO2 Analyze th CO3 Apply the CO4 Analyze th CO6 Study the Microsco BLOOM'S LEVEL CO CO1 CO1 CO2 CO3 CO4 CO5 CO6 Ref: BOS/SME/BME	and interpret to and interpret to another interpret	Interactions in SE OUTCOMES Understand (L2)	BI Apply (L3)	n in Journ lubrican	vel Analyze (L4)	Evalua (L5)	1,2,4 1 te	1,2 1,2 Create (L6)

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	P02	PO3	PO4	PO5	90d	PO7	PO8	60d	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	2												3	3	
CO2	3	2											3	3	
CO3	3	3	1										3	3	
CO4	3	3											3	3	
CO5	3	2		2									3	3	
CO6	3												3	2	
Average	2.8	2.5	1	2									3	2.8	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: Introduction to tribology, History of tribology, Interdisciplinary approach, Economic benefits. Tribological Design of Oil seals, Gaskets.

Friction: Laws of friction - Stick-slip phenomenon, Friction characteristics of metals and non-metals.

Unit-2

Wear - Wear mechanisms – Interfacial wear and Chemical Wear-Wear measurements - Ferrography and oil analysis.

Lubrication & Bearings: Lubrication types, Regimes, Basic Modes of Lubrication, Properties of Lubricants. Types of bearings.

Unit-3

Hydrodynamics Lubrication: Fluid film in simple shear, Mechanism of pressure development in a convergent film, pressure induced, and velocity induced flows, Reynold's equation for fluid film lubrication, Load carrying capacity of slider bearing & Journal bearing Pressure development.

Unit-4

Lubrication in Bearings: Sommerfeld Number, Friction – Petroff's equation – Oil flow and Thermal equilibrium. Gas Lubricated Bearings.

Nanoscale Tribology: Interatomic Interactions, Atomic Force Microscope (AFM), Automotive Tribology.

CASE STUDIES

- 1. Study on Systematic oil analysis in late 1940s with the railways. The early applications were oriented toward avoiding catastrophic and costly failures of engines in operation and Success in rail engines.
- 2:.Study on Derailment of Train upon deformed bearing hub.
- 3. Study on Premature Bearing failures in Brick Clay mill.
- 4. Study on Jaw Crusher Machine Failure.

TEXT BOOKS

- 1. Gwidon W Stachowiak and Andrew W Batchelor, "Engineering Tribology", Butterworth-Heinemann. 2013.
- 2. K.C. Ludema, "Friction, Wear, Lubrication", CRC Press, 2010.

REFERENCE BOOKS

- 1. Majumdar.B.C, Introduction to Tribology of Bearings, Universal Books, 2010.
- 2. Bharat Bhushan, Introduction to Tribology, John Wiley & Sons, 2013.

JOURNALS/MAGAZINES

- 1. https://www.journals.elsevier.com/tribology-international
- 2. https://www.mdpi.com/journal/lubricants

SWAYAM/NPTEL/MOOCs

- 1. https://nptel.ac.in/courses/112102015
- 2. https://onlinecourses.nptel.ac.in/noc20_mm12/preview

Course Title	Sola	ar Energy Sy	stems		Cour	se Type	Soft Core		
Course Code	B20ERS723	Credits	3	3	С	lass	s VII sem		
	TLP	Credits	Contact	Work	Total N	umber of	Accoca	sment in	
	ILF	Credits	Hours	Load	Classes				
Course	Theory	3	3	3	Per Se	emester	Weightage		
Structure	Practice	0	0	0	Theory	Practical	IA	SEE	
	Tutorial	0	0	0	Theory	riactical	IA	SEE	
	Total	3	3	3	39	0	50 %	50 %	

B20ERS723	Credits		3	-				
TLP	5.54.65	1		(1	ass	VII sei	mester	
ĺ	TLP Credits Contact Work Total Number of Hours Load Classes Weightage							
Theory	Theory 3 3 3 Per Semester Weightage							
Practice	0	0	0	Theory	Practical	IΔ	SFF	
Tutorial	0	0	0	icoi y	actical	IL.	JLL	
Total	3	3	3	39	0	50 %	50 %	
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requirements al friendly Ther	, Interpret to mal and PV sy	he data	and de	sign the	sustainable	1,2,3,5,6,	7 1,2,3	
		Ble	oom's Le	vel				
ember Un	derstand (L2)	Apply (L3)		Analyze (L4)	Evalua (L5	ate)	Create (L6)	
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	Tutorial Total is designed to hotovoltaic system as a sification, workedge of difference types of photos. alyze the There is (COs) e course the state the solar geo sure solar radial erent solar construction and the knowledge rent types of Proge. requirements all friendly There THECOURSE OUT THE	Tutorial 0 Total 3 is designed to provide completo on the control of the contro	Tutorial 0 0 Total 3 3 is designed to provide comprehensive thotovoltaic systems, the solar thermore storage devices, Photovoltaic systems and earth georesistication, working of thermal energy edge of different available technologic express of photovoltaic systems, used allowed the Thermal and Photovoltaic systems are course the student shall be able to: Course Outcomes the solar geometry, construction and source solar radiation. For each of PV system applications for the knowledge on construction and working of thermal energy energy to the solar collector systems and some struction and working of thermal energy energy to the solar geometry, construction and working of thermal energy energy to the solar collector systems and some struction and working of thermal energy energy to the solar collector systems and some struction and working of thermal energy energy to the solar part of the solar geometry, construction and working of thermal energy energy to the solar part of the solar geometry and solar part of the solar geometry. For each of the solar geometry and solar part of the solar geometry and solar part of the solar geometry and solar part of the solar geometry. For each of the solar geometry and solar part of the solar par	Tutorial 0 0 0 0 0 Total 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	Tutorial 0 0 0 0 Theory Total 3 3 3 399 is designed to provide comprehensive knowledge on so thotovoltaic systems, the solar thermal collectors and the storage devices, Photovoltaic systems, types, and their sic knowledge on solar and earth geometry, the different solar dedge of different available technologies to store the solar etypes of photovoltaic systems, used to convert the solar etypes of photovoltaic systems, used to convert the solar decorate the solar decorate the student shall be able to: Course Outcomes It the solar geometry, construction and working of instructure solar radiation. For each solar collector systems and select suitable solar province of PV system applications for stand-alone with the solar geometry, Interpret the data and design the pal friendly Thermal and PV systems for the society. THECOURSE OUTCOMES Bloom's Level THECOURSE OUTCOMES	Tutorial 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Solar Energy Systems Course Type Soft B20ERS723 Credits TLP Credits Hours Load Classes TLP Credits Hours Load Classes Weight Theory 3 3 3 Per Semester Practice 0 0 0 Theory Practical IA Total 3 3 3 9 0 50 % Is designed to provide comprehensive knowledge on solar radiation, fundamentovoltaic systems, the solar thermal collectors and their applications. It also yet storage devices, Photovoltaic systems, types, and their applications. It also yet solar gedevices, Photovoltaic systems, types, and their applications. Sick knowledge on solar and earth geometry, the different devices used to meast selfication, working of thermal energy storage devices and their applications. The solar energy is the types of photovoltaic systems, used to convert the solar energy into electric types of photovoltaic systems, used to convert the solar energy into electric solar energy into electric solar collector systems and select suitable solar collector. Course the student shall be able to: Course Outcomes Course Outcomes Course Outcomes POs I the solar geometry, construction and working of instruments sure solar radiation. Ponstruction and working of thermal energy storage systems. 1 the knowledge on construction and working of solar PV cells. 1 cent types of PV system applications for stand-alone with and without ge. PHECOURSE OUTCOMES Bloom's Level Tequirements, interpret the data and design the sustainable, al friendly Thermal and PV systems for the society. 1 (12) (13) (14) (15) 1 (15) 1 (15) 1 (16) 1 (17) 1 (18) 1 (19) 1 (19) 1 (19) 1 (19) 1 (19) 1 (19) 1 (19) 1 (19) 1 (19) 1 (19) 1 (10) 1 (10) 1 (10) 1 (10) 1 (10) 1 (11) 1 (12) 1 (13) 1 (14) 1 (15)	

			Bloom's Level										
СО	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)							
CO1		✓											
CO2		✓											
CO3		✓											
CO4		✓											
CO5		✓											
CO6				✓									

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	P02	PO3	PO4	PO5	P06	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3												3		
CO2	3												3		
CO3	3												3		
CO4	3												3		
CO5	3												3		
CO6	3	3	2		1	2	3						3	2	2
Average	3	3	2		1	2	3						3	2	2

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Introduction: - Solar radiation at the earth's surface, Sun and earth geometry, Solar constant, Solar angles, sunrise, sunset and day length, Instruments for measuring solar radiation and Sunshine, Simple Numerical on Solar radiation geometry

Unit-2

Solar Thermal Collectors: Classification of solar collectors, Flat plate collectors with plane reflectors, cylindrical parabolic collector, Compound parabolic collector (CPC), Paraboloid dish collector, Central receiver collector. Transmissivity of the cover system, Alternative to the conventional collector.

Thermal energy storage: Need for solar thermal energy storage, Sensible heat storage, Latent heat storage, Thermochemical storage.

/Unit-3

Solar Photovoltaic System: Working principle of Photovoltaic system, Current voltage characteristics of a solar cell, Types of solar cells: Crystalline silicon solar cells, Thin-film solar cells, multifunctional solar cells, other solar cells, Losses in solar cells and solar modules, Photovoltaic modules in series and parallel

Unit-4

Photovoltaic system and its applications: Stand-alone system with and without battery storage and with AC and DC load, Grid connected, Concentrated photovoltaic systems, satellite power station.

Design of Solar Thermal and Photovoltaic: Design of solar flat plate collector system, Design of PV system for domestic applications.

Discussion on use of software for installation of Solar PV Cells, Flat plate collectors and other applications.

CASE STUDIES

- 1. Prepare a report on latest specifications and problems of solar water heaters to be implemented for a residential purpose for heating water.
- 2. Prepare a report on specifications and devices used for a solar roof top PV Systems for a residential purpose.
- 3. Prepare a report on power saving, money saved by using a solar roof top invertor.
- 4. Preparer a report on the power developed by solar power plant and problems faced.
- 5. Prepare a survey report on development of solar power plants in Karnataka.
- 6. Prepare a survey report on development of solar power plants in India.
- 7. Prepare a report on the specifications of devices used for measuring the solar energy.
- 8. Using solar PV software calculate the different parameters for solar panels.

TEXT BOOKS

- 1. S P Sukhatme and J K Nayak, "Solar Energy", McGraw Hill Education (India) Private Limited, 4th Edition, 2017.
- 2. John A Duffie and William A Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, Inc., 4th edition April 2013

REFERENCE BOOKS

1. Martin A Green, "Solar cells: operating principles, technology, and system applications", Prentice-Hall series in solid state in physical electronics, Longman Higher Education, 1st Edition, 1982.

2. Garg. H.P, Prakash.J, "Solar energy fundamentals and applications", Tata McGraw Hill publishing Co. Ltd, 1st Edition, 2017.

- 3. Yogi Goswami.D, Frank Kreith, Jan F.Kreider, "Principle of solar engineering", Taylor and Francis, 2nd Edition, 2000.
- 4. Chetan Singh Solanki, "Solar Photovoltaic technology and systems: A manual for Technicians, Trainers and Engineers", PHI Learning private limited, 1st Edition, 2013.

JOURNALS/MAGAZINES

- 1. https://www.journals.elsevier.com/solar-energy-materials-and-solar-cells
- 2. https://www.journals.elsevier.com/solar-energy

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/115103123
- 2. https://www.coursera.org/learn/photovoltaic-solar-energy
- 3. https://www.coursera.org/learn/solar-energy-basics
- 4. https://onlinecourses.nptel.ac.in/noc20_ee57

Course Title	Auto	nomous V	'ehicles		Cour	se Type	Soft Core		
Course Code	B20ERS724	Credits	3	/ ^	С	lass	VII Semester		
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in	
Course	Theory	3 /	3	3	Per Se	emester	Weightage		
Structure	Practice	0	0	0	Theory	Practical	IA	SEE	
	Tutorial	0	0	0	Theory	Fractical	I A	JEE	
	Total	3	3	3	39	0	50 %	50 %	

COURSE OVERVIEW

The goal of the course is to introduce students to the various technologies and systems used to implement advanced driver assistance systems. These systems have the overall impact of automating various driving functions, connecting the automobile to sources of information that assist with this task, and allowing the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants.

COURSE OBJECTIVES

- 1. Introduce the fundamental aspects of Autonomous Vehicles.
- 2. Gain Knowledge about the Sensing Technology and Algorithms applied in Autonomous vehicles.
- 3. Understand the Connectivity Aspects and the issues involved in driverless cars.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

со	Course Outcomes	POs	PSOs
CO1	Describe the evolution of Automotive Electronics and the operation of	1,2	1,2
	ECUs.	,	
CO2	Compare the different type of sensing mechanisms involved in	1,2	1,2
COZ	Autonomous Vehicles.	1,2	1,2
CO3	Discuss about the use of computer vision and learning algorithms in	1,2	1,2
003	vehicles.	1,2	1,2
CO4	Summarize the aspects of connectivity fundamentals existing in a		
004	driverless car.	1,2	1,2
CO5	Identify the different levels of automation involved in an Autonomous	1,2	1,2
(03	Vehicle.	1,2	1,2
CO6	Outline the various controllers employed in vehicle actuation.	1,2	1,2

BLOOM'S LEVEL OF THE COURSE OUTCOMES

			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		٧				
CO2		٧				
CO3		٧				
CO4		٧				
CO5		٧				
CO6		٧				

COURSE ARTICULATION MATRIX

CO/ POs	PO1	P02	PO3	P04	PO5	P06	PO7	PO8	P09	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	2	1											1	1	
CO2	1	2				<							1	1	
CO3	2	2				\wedge		/					1	2	
CO4	2	2											1	2	
CO5	2	2				\wedge	> /	/					1	2	
CO6	2	3											1	2	
Average	1.8	2				/	/						1	1.6	

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit 1

Introduction: Evolution of Automotive Electronics, Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs -Infotainment, Body, Chassis, and Powertrain Electronics, Advanced Driver Assistance Systems, Autonomous Vehicles

Unit 2

Sensor Technology for Autonomous Vehicles: Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems, Camera Technology -Night Vision Technology, Use of Sensor Data Fusion, Kalman Filters

Unit 3

Computer Vision and Deep Learning for Autonomous Vehicles: Computer Vision Fundamentals -Advanced Computer Vision, Neural Networks for Image Processing, Tensor Flow, Overview of Deep Neural Networks, Convolutional Neural Networks Connectivity Fundamentals, DSRC (Direct Short Range Communication), Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Security Issues.

Unit 4

Autonomous Vehicle Technology Driverless Car Technology-Different Levels of Automation, Localization, Path Planning. Controllers to Actuate a Vehicle, PID Controllers, Model Predictive Controllers, ROS Framework, Technical Issues, Security Issues, Moral and Legal Issues.

TEXT BOOKS

- 1. Hong Cheng, "Autonomous Intelligent Vehicles: Theory, Algorithms and Implementation", Springer, 2011.
- 2. Williams. B. Ribbens: "Understanding Automotive Electronics", 7th Edition, Elsevier Inc., 2012.

REFERENCE BOOKS

- 1. Shaoshan Liu, Liyun Li, "Creating Autonomous Vehicle Systems", Morgan and Claypool Publishers, 2017.
- 2. Marcus Maurer, J.ChristianGerdes, "Autonomous Driving: Technical, Legal and Social Aspects" Springer, 2016.

- 3. Ronald.K.Jurgen, "Autonomous Vehicles for Safer Driving", SAE International, 2013.
- 4. James Anderson, KalraNidhi, Karlyn Stanly, "Autonomous Vehicle Technology: A Guide for Policymakers", Rand Co, 2014.

5. Lawrence. D. Burns, ChrostopherShulgan, "Autonomy – The quest to build the driverless car and how it will reshape our world", Harper Collins Publishers, 2018

JOURNALS/MAGAZINES

- 1. Journal of Autonomous Vehicles and Systems
- 2. International Journal of Vehicle Autonomous Systems

SWAYAM/NPTEL/MOOCs

- 1. https://www.mooc-list.com/course/introduction-self-driving-cars-coursera
- 2. https://www.mooc-list.com/course/decision-making-autonomous-systems-edx
- 3. https://www.mooc-list.com/course/visual-perception-self-driving-cars-coursera

Course Title	Op	eration Rese	arch		Cours	е Туре	Soft core		
Course Code	B20ERS725	Credits	/ :	3	С	lass	VII semester		
	TLP	Credits	Contact Hours	Work Load		umber of asses		sment in ghtage	
Course	Theory	/3	3	/ 3	Per Se	emester	vveigiitage		
Structure	Practice	0	/0/	0	Theory	Practical	IA	SEE	
	Tutorial	0	0	(0	Mediy	Tactical	1/4	JLL	
	Total	3	3	3	39/	0	50 %	50 %	

COURSE OVERVIEW

The course of operation Research focuses on optimization. Optimization problems arise in all walks of human activity –particularly in engineering, business, finance and economics. The simplest optimization problems are linear in nature which may be subject to a set of linear constraints. This course will equip the student with the expertise to mathematically solve problems in linear programming, transportation, Waiting lines, sequencing, Game Theory and subsequently educate the student to solve these problems with the help of the available methods.

COURSE OBJECTIVES

- 1. Learn Fundamentals of OR, Formulation of an LPP. And determine the optimal solution fora LPP Problem
- 2. Learn applications of LPP such as transportation problem, Assignment problem, travellingsalesman problem
- 3. Analyze the waiting line model for real world applications.
- 4. Determine the project completion time by using PERT and CPM.
- 5. Determine the scheduling of machines in the shop floor by using Johnson's algorithm.
- 6. Understand the conflict between the two players in a game and determine the best strategy for the play.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

СО	Course Outcomes	POs	PSOs
CO1	Formulate & Analyze the different models of Operation research & their	1,2,12	1,2
001	applications.	1,2,12	1,2
CO2	Solve transportation problem to determine optimal route and assignment for real	1,2,12	1,2
COZ	time applications.	1,2,12	1,2
CO3	Design and develop a model to improve decision making and objective analysis of	1,2,3,12	1,2
COS	decision problems.	1,2,3,12	1,2
CO4	Interpret the characteristics of various waiting line problems	1,2,12	1,2

CO5	Determine optimal sequencing and best strategy of the play	1,2,12	1,2
CO6	Ascertain the optimization techniques to real life problems	1,2,12	1,2

CO5 Dete	rmine	ontima	al segi	iencing	and be	st stra	ntegy o	f the n	lav				1 2	12	12
CO6 Asce	rtain t	he opt	imizati	ion tecl	nniques	to rea	al life p	roblen	1s				1,2	,12	1,2
BLOOM'S L	EVELO	F THEC	OURS	E OUT	OMES		<u> </u>						1	<u> </u>	<u> </u>
							Ble	oom's	Level						
СО	R	ememl	oer	Unde	rstand		Apply		Anal	yze	Ev	/aluate		Crea	ite
		(L1)		(L	.2)		(L3)		(L4	1)		(L5)		(L6	5)
CO1				•	/										
CO2										<u>'</u>					
CO3									- ✓	,					
CO4									✓	,	+				
CO5									✓	,	1				
CO6	TIC:::	AT:01:	D 4 4 7 7	17						•					
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CO/ POs	,01	,00	03	0,0	,05	90,	70,	80,	60,	,01C	011	,012	501	\$00	503
CO1	3	2		-						-		1	3	3	-
CO2	3	3										1	3	3	
CO3	3	2	3				//					1	3	3	
CO4	3	3									,	2	3	3	
CO5	3	3										2	3	3	
1	3	3					, ,					3	3	3	
COURSE CO	N, 2-M	edium,	, 3-Hig	h			Unit-	1				1.67	3		
CO5 Dete CO6 Asce BLOOM'S L CO CO1 CO2 CO3 CO4 CO5 CO6 COURSE AF CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov COURSE CO	ONTEN	edium, T Operation	on Re	search:	: Definit	tion, S	Unit- icope o	of OR,	OR Mc	odels, (Charactions in	teristics	and praphic	phases	of OF
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CO2	3	3										1	3	3	
CO3	3	2	3		/							1	3	3	
CO4	3	3				/						2	3	3	
CO5	3	3										2	3	3	
CO6	3	3										3	3	3	
Average	3	2.6	3									1.67	3	3	

Sequencing: Johnson's algorithm, Assumptions in sequencing, n jobs to 2 machines, n jobs on 3 machines, n jobs on m machines, 2 jobs on n machines, graphical solution priority rules, processing of n jobs through m machines.

CASE STUDIES

- 1. Develop a python programming for solve linear programming problem.
- 2. Formulation of the problem by using linear programming model for managing of waste in metropolitan cities.
- 3. Optimization of the optimal route and cost for connecting various cities in the state.
- 4. Analyzing the various characteristics of the queuing system in day to day service sector.
- 5. Application of network techniques for various manufacturing and service sector- A case study

TEXT BOOKS

- 1 Prem Kumar Gupta and D.S.Hira, "Problems in Operations Research", S.Chand Publication, New Delhi, 2021.
- 2.S.D.Sharma, "Operations Research", Kedar Nath Ram Nanth, New Delhi, 8th Revised Edition 2017

.REFERENCE BOOKS

- 1 Fredericks Hiller and Gerald J Liberman, "Introduction to Operation Research", Tata McGraw hill, Special Indian edition 9th Edition, 2017.
- 2. Taha.H.A, "Operation Research: An Introduction", Pearson Education Indian Edition, 2014.
- 3. A Ravindran, "Operation Research: Principles and Practice", John Wiley and Sons Ltd, 2nd Edition, 2004.
- 4. S Kalavathy, "Operation Research", Vikas Publishing house Pvt Ltd, 3rd Edition, 2009

JOURNALS/MAGAZINES

- 1. https://www.inderscience.com/jhome.php?jcode=ijor
- 2. https://www.springer.com/journal/12597

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/110106062
- 2. https://nptel.ac.in/courses/112106131

Course Title		Internship			Cour	se Type	Sof	t core
Course Code	B20ERS726	Credits	3	3	C	lass	VII se	mester
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Structure	Practice	3	3	3	Theory	Practical	IA	SEE
	Tutorial	0 \	0	0	THEOLY	Fractical	IA	JLL
	Total	3	3	3	0	39	50 %	50 %

COURSE OVERVIEW

The internship in field of study is essential to successful outcomes after graduation. Classroom environment may involve only with discussion, debate, peer interaction, and shared learning experiences. But it is important to seek opportunities for a student to apply academic concepts according to industrial requirements.

COURSE OBJECTIVES

- 1. To gain a practice-oriented and 'hands-on' working experience in the real world and to enhance the student's learning experience.
- 2. To develop a right work attitude, self-confidence, interpersonal skills and ability to work as a team in real organizational setting.
- 3. To enhance operational, customer service, life-long knowledge and skills in a real world work environment.
- 4. To get pre-employment training opportunities and an opportunity for the company or organization to assess the performance of the student and to offer an employment opportunity after his/her graduation, if it deems fit.

.COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to: O	After the com	pletion	of t	he cou	urse, th	e stude	ent wil	l be ab	le to:						
col solve real life challenges in the workplace by analyzing work environment and conditions, and selecting appropriate skill sets acquired from the course. Ozo Demonstrate the application of knowledge and skill sets acquired from the course and propositions, and selecting appropriate skill sets acquired from the course and conditions, and selecting appropriate skill sets acquired from the course and conditions. Articulate career options by considering opportunities in company, sector, industry, professional and educational advancement. Communicate and collaborate effectively and appropriately with differently, 10, 11, 1, 2 increasionals in the work environment through written and oral means. Communicate and collaborate effectively and appropriately with differently, 10, 11, 1, 2 increasionals in the work environment through written and oral means. Communicate and collaborate effectively and appropriately with differently, 10, 11, 1, 2 increasing states and problem solving skills by analyzing underlying issue/s to challenges. Communicate and collaborate effectively and appropriately with differently, 10, 11, 1, 2 increasing states and problem solving skills by analyzing underlying issue/s to challenges. Communicate and collaborate effectively and appropriately with differently, 1, 2, 3, 4 increasing states and professional ethics by displaying positive disposition during internship increase. Communicate and collaborate effectively and appropriately with differently, 1, 2, 5, 6 increase (Li, 2, 3, 4 increase	СО					Cou	rse Ou	itcome	S					POs	PSOs
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Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means. Exhibit critical thinking and problem solving skills by analyzing underlying issue/s to the challenges. CO6 Exhibit professional ethics by displaying positive disposition during internship TO8 THEORY SEVELOF THECOURSE OUTCOMES BIOOM'S LEVELOF THECOURSE OUTCOMES BIOOM'S LEVELOF THECOURSE OUTCOMES CO1	CO3 Articula	ate car	eer o	option ducat	s by co	onsideri dvance	ng op ment.	portun	ities ir	comp	any, se	ctor, i	ndustry	1, 2, 5,	6 1, 2
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Student should prepare a comprehensive report to indicate what he/she has observed and learnt in the training period. The student may contact Faculty Mentor taking guidance on how to make presentation and preparation of report. Student should prepare the final report on internship topic. The Internship report will be evaluated on the basis of following criteria: I. Originality. II. Adequacy and purposeful write-up. III. Organization, format, drawings, sketches, style, language etc. IV. Variety and relevance of learning experience. V. Practical applications, relationships with basic theory and concepts taught in the course.	COURSE CONT Student shoul semester class	TENT d do in	itern:	ship fo	or 21 da p can b	ays in o be comp	ne str oleted	etch oi during	15 da	ys in tw ımmer	vo slot or wint	before ter vac	the co	mmence	ment of
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Ref: BOS/SME/BME-2020-21-20.06.20/2021-22-05.06.21/2022-23-25.06.22/2023-24-10.06.23	 To enable the power plant To help the alternatives, To provide the power plant To impart knew batteries and course outcomment Course outcomment Course outcomment 	specifications. nowledge on various energy management and control strategies, energy storage system d alternate energy storage systems like fuel cells. DMES (COs) letion of the course, the student will be able to: Course Outcomes POs PSe the systems of electric vehicles, hybrid electric vehicles and their e to society and environment.

CO	Course Outcomes	POs	PSOs
CO	Describe the systems of electric vehicles, hybrid electric vehicles and their	1,6,7	1
CO.	relevance to society and environment.	1,0,7	

1 ((())	Recognize different configurations of power trains used in hybrid vehicles and identify the hybrid load tracking architectures.	1	1
L CO3	Illustrate the working of different types of electrical machines, motors and drive topologies.	1	1
I (() <u>A</u>	Demonstrate the electric propulsion unit and Identify the communication protocols and technologies used in vehicle networks.	1	1
1 (() 5	Analyze performance of battery based energy storage and problems associated with battery systems used in electric hybrid vehicles.	1, 2	1
CO6	Describe the characteristics of fuel cell technology.	1	1

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CO3	trate the	e worki	ng of d	ifferent	t types	of elec	trical m	achine	s, moto	rs and	drive	1		1	
CO4 Dem	onstrat ocols ar	e the el	ectric nologie	propuls	ion uni	t and lo	dentify works.	the cor	nmunic	cation		1		1	
CO5 Anal	yze per	forman	ce of	battery	based	energy	/ storag	ge and	proble	ms ass	ociated	1, 2	2	1	
CO6 Desc	ribe the	charac	teristi	cs of fu	el cell t	echnol	ogy.					1		1	
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CO2	3/					~//			///				3		
CO3	3							\					2		
CO4	3		<u> </u>								· /		3		
CO5	3	1											2		
CO6	2							\rangle			~		3		
Average	2.8	1				2	2						2.5		
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Hybrid Elec	ctric Dr	ive-trai	ns: Ba	sic Arc	hitectu	re of H	Hybrid	Drive T	rains,	Energy	Saving	s Pote	ntial o	f Hybri	d
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CO/ POs	PO1	PO2	EOd	P04	POS	90d	204	PO8	60d	010d	PO11	PO12	PSO1	PS02	PS03
CO1	З	/	\wedge	//		2	<u>/2</u>			/			2		
CO2	3					/			//				3		
CO3	3						//	\					2		
CO4	3										\ /		3		
CO5	3	1											2		
CO6	2												3		
Average	2.8	1				2	2 /						2.5		

Control Systems for the EHV and EVs: In vehicle networks- CAN, Energy Management Strategies: Energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

Unit-4

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery Parameters, Different types of Battery used in EHVs, Battery based energy storage and its analysis, Problems associated with battery systems in EHVs, Temperature controlling methods, advanced battery technologies.

Fuel Cells: Fuel Cell Characteristics - Fuel Cell Types — Alkaline Fuel Cell - Proton Exchange Membrane - Direct Methanol Fuel Cell - Solid Oxide Fuel Cell- Hydrogen Storage Systems- Reformers - Fuel Cell EV - Super and Ultra Capacitors - Flywheels.

TEXT BOOKS

- 1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", 4th Edition, CRC Press, 2003.
- 2. M. Ehsani, Y. Gao and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", 2nd Edition, CRC Press, London, 2010.
- 3. James Larminie, John Lowry, "Electric Vehicle Technology", Wiley publications, 3rd Edition, 2003.

REFERENCE BOOKS

- 1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 3rd edition, Wiley, 2003
- 2. Seth Leitman, "Build Your Own Electric Vehicle" McGraw-Hill, 2nd Edition, 2013.
- 3. Chris Mi, M A Masrur, D W Gao, "Hybrid Electric Vehicles Principles and applications with practical perspectives", 4th edition, Wiley, 2011

4. C.C Chan, K.T Chau, "Modern Electric Vehicle Technology", Oxford University Press Inc., New York 2001

JOURNALS/MAGAZINES

- 1. https://www.sciencedirect.com/book/9780444535658/electric-and-hybrid-vehicles
- 2. https://www.scimagojr.com/journalsearch.php?q=11600153305&tip=sid

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/108/103/108103009/
- 2. https://www.edx.org/course/electric-cars-technology
- 3. https://www.classcentral.com/course/edx-hybrid-vehicles-10285

Course Title		Design Lab			Cours	se Type	Hard Core		
Course Code	B20ER0705	Credits	1		/ C	lass	VII Se	mester	
	TLP	Credits	Contact Hours	Work Load	/	umber of asses		sment in	
Course	Theory	0	(0	0	Per Se	emester	weig	ghtage	
Structure	Practice 1		2	2	Theory Practical		IA	SEE	
	Tutorial	0	0	0	THEOTY	Tractical	IA.	JLL	
	Total	1	2	2	0	26	50 %	50 %	

COURSE OVERVIEW

The course deals with the free and forced vibrations under un-damped and damped conditions for single degree of freedom mechanical systems. It also deals with the critical speed of a rotating shaft. This lab helps the manufacturing sector in analyzing the vibration measurement and Noise Engineering. Also study the mode shapes of cantilever beam. The course further deals with experimental stress analysis.

COURSE OBJECTIVES

- 1. To enable the students to understand the theoretical principles of vibration and vibration analysis techniques for the practical solution of vibration problems.
- 2. To analyze the free and forced (harmonic, periodic, non-periodic) vibration analysis of single degree of freedom linear systems.

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3. To enabl 4. To predict 5. To analy: COURSE OF After the co CO Estir dem shap repo CO2 CO3 CO6 CO4 CO4 CO5 Local CO5 Local CO5 CO6 CO6 CO6 CO6 CO6 CO7	a tha c	tudent	s to de	atermin	ne coun	d nrac	cura la	val ma	acuram	ent in	snacif	ied acou	ustic e	nviron	ment
4. To predic	e uie s ct stres	s level	s to ut s using	the co	ncents	of Pho	oto elas	verme sticity.	asuren	ient in	specii	ieu acot	ustic e	11011011	ment.
5. To analy:	ze the	parame	eters (Princip	al Stress	ses an	d Straii	ns) usii	ng strai	n roset	tes.				
COURSE O	JTCON	/IES (CC)s)												
After the co	omplet	ion of t	he co	urse, th	ne stude	ent wil	l be ab	le to:							
СО					Cours	e Out	comes						POs	;	PSOs
Estir	nate 1	the na	tural	freque	ncy for	long	itudina	al and	torsio	nal sy	stems	and			
CO1 dem	onstra	ite a ph	ysical	unders	tanding	of dar	mping a	as well	as freq	uencie:	s and r	node 1	L, 4, 9,	10	1, 2
renc	oes of	engine	erea	system	s and r	ecora	tne re	esuits	in the	torm c	or tecr	inicai			
Com	pute t	he natu	ural fr	eauenc	v for fo	rced v	ibratio	n of a	single c	degree	of free	edom			1. 2
CO2 of u	n-dam	ped sys	tems	and rec	ord the	result	ts in th	e form	of tech	nnical r	eport.	1	L, 3, 9,	10	•
CO3 Com	pute t	he criti	cal sp	eed of	rotating	g shaft	and r	ecord t	he resi	ults in 1	the fo	rm of 1	1 2 0	10	1, 2
tech	nical r	eport.											L, J, J,	10	
Pred	lict the	vibrati	ion us	ing mea	asuring	instru	ments	and no	ise red	uction	techni	iques			1, 2
CO4 to re	eal tim	e engir	eerin	g probl	ems and	d reco	rd the	results	in the	torm o	ot tech	nical 1,	4, 6, 9	∌, 10	
repo	fv the	Photo	elacti.	city pri	ncinles	for cti	ress an	alveie	and re	ord th	e recii	lts in			1 2
CO5 the	form o	f techn	ical re	port.	icipies	יטי אנו	انه دی	arysis (and IEC	Jord III	c iesu	1 1	L, 2, 9,	10	±, ∠
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CO6 load	ing us	ing stra	in ros	settes,	compar	e it w	ith the	oretic	al value	es and	recor	d the 1	L, 2, 9,	10	
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CO3 CO4 CO5 CO6 COURSE AF CO/ POs CO1 CO2	2 2	V ATIONI	MATR © 3	3 IX	MOS	90d	P07	800	60d 3 3	3 3 3	PO11	P012	3 3	20 3 3	PS03
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CO3 CO4 CO5 CO6 COURSE AF CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average	2 2 3 3 2.5	√ ATION 7 8 9 1 1 3 3 3 3 edium ,	3 3 3	1X	SOO BOS	3	V 000	804	60 <u>a</u> 3 3 3 3 3 3 3	3 3 3 3 3 3	PO11	PO12	3 3 2 3 2 2.7	3 3 3 2 3 2 3 2.8	PSO3
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CO3 CO4 CO5 CO6 COURSE AF CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	2 2 3 3 2.5 w, 2-M	ATION CO 3 3 3 edium, of nature of free	MATR SOLUTION 3 3 3-Higher and free domestic and solution in the solution in	IX 3 3 h equency	y, logaring system	3 3 thmic ms (lo	Part-decrer	A nent, o	3 3 3 3 3 3 3 4 damping	3 3 3 3 3 3 3 3 3	and da	BO15	3 3 2 3 2 2.7	3 3 3 2 3 2.8	SOS and a
CO3 CO4 CO5 CO6 COURSE AF CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov 1. Determine single of 2. To study	RTICUL 2 2 3 3 2 3 2.5	ATIONI COA 3 3 3 Gedium, of nature of free reed da	MATR SO 3 3 3-Hig	IX 3 3 hequency	y, logaring system	90d 3 thmic ms (loopring r	Part-decrer	A nent, conal and estem.	3 3 3 3 3 3 3	910d 3 3 3 3 3 3 3 3	and da	amping P015	3 3 2 3 2 2.7	3 3 3 2 3 2.8	SO3
CO3 CO4 CO5 CO6 COURSE AF CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov 1. Determine single of 2. To study	2 2 2 3 3 2.5 w, 2-M	ATION CO 3 3 3 edium, of nature of free erced da	MATR SO 3 3 3-Higher and free addomination of the company of t	IX 3 3 h equency vibratin l vibrati	y, logaring systemion of sp	3 3 thmic ms (looring r	Part-decrer ngitudi mass sy	A nent, conal and estem.	3 3 3 3 3 3 damping d torsio	3 3 3 3 3 3 3	and da	amping	3 3 2 3 2 2.7	3 3 3 2 3 2.8	rosa n a
CO3 CO4 CO5 CO6 COURSE AF CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov 1. Determine single of 2. To study Ref: BOS/SME	RTICUL 2 2 3 3 2.5 w, 2-M nation degree the fo	ATIONI COA 3 3 3 edium, of nature of free reed da	3 3 3-Hig	IX 3 3 4 Sequency vibratin vibration vibra	y, logaring systemion of sp	90d 3 3 thmic ms (loopring rest)	Part-decrerngitudinass sy	Anent, conal and estem.	60 3 3 3 3 3 3 3 3 4 d torsio	9100 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	and da	amping B015	3 3 2 3 2 2.7	3 3 3 2 3 3 2.8 cient in	PSO3
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			Bloom	s Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1	1	/ /				
CO2		4 /\				
CO3			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	\ \ \		
CO4	✓			/ /	✓	
CO5		7	/ / /			
CO6	✓	1				

CO/ POs	PO1	P02	PO3	P04	PO5	P06	P07	P08	PO9	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	2			3					3	3			3	3	
CO2	2		3						3	3			3	3	
CO3	3		3						3	3			2	3	
CO4	3			3		3			3	3			3	2	
CO5	2	3							3	3			3	3	
CO6	3	3							3	3			2	3	
Average	2.5	3	3	3		3			3	3			2.7	2.8	

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3.	Determination of	critical speed of	a rotating sh	naft.					
4.	Vibration measure	ements by accele	erometers/ L	aser Dop	pler/ Vib	rometer/	μ-flown pro	bes.	
5.	Determination of	natural frequenc	cy of beam /	plate by 6	experime •	ental mode	el analysis.		
1	Determination of	Drincinal Stress	es and stra	Part- inc in a r	b nember	subjected	to combine	ed loading	using Strain
1.	rosettes	Fillicipal Stress	ses and sua	iiis iii a i	пениен	subjecteu	to combine	eu ioauilig	using strain
2.	Determination of	Fringe constant	of photo ela	stic mate	rial using	ζ.			
	a) Circular disc su	bjected to diame	etral compre	ession.		,			
	b) Pure bending s	pecimen (four p	oint bending	g).					
3.	Determination of	stress concentra	ition using P	hoto elas	ticity for	rectangul	ar plate with	h a hole un	der tension.
4.	Determination of	Pressure distribu	ution in Jour	nal bearir	ng.				
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1.	S. S. Kao, "Mechal	nicai vibrations"	, rearson Ed	ucation I	iic, b" ec	aition, 201 chapical Y	D. ibrations" ⁻	[a+a N4a○	wy Hill
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3. 1	Sadhu Singh "Evn	vorimontal Stross	Analycic" K	hanna Di	ation inc	,, 5 Euitic	2000.		
4. 5	Srinath I S "Exp	erimental stress	Analysis" Ta	ta McGra	w Hill N	ew Delhi	2009.		
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1.	G. K.Grover, "Med	chanical Vibratio	ns", Nem Ch	and and	Bros.				
2.	W. T. Thomson, "	Theory of Vibrati	on with App	lications'	', Pearso	n Educatio	on Inc, 5 th Ec	dition, 2008	3.
3.	V. P. Singh, "Mech	nanical Vibration	s", Dhanpat	Rai & Co	mpany, 3	rd Edition,	2006.		
4.	Jindal, "Experime	ntal stress analy	sis", Pearsor	n Publishe	ers, 2018				
5.	J.Srinivas, "Stress	analysis-An intr	oduction to	Experime	ntal Tech	nniques", I	Narosa Publ	ishers, 201	.5.
JC	DURNALS/MAGAZI	INES					/,)		
1.	Journal of Sound a	and Vibration		(/ ,					
2.	Journal of Vibration	on Engineering &	Technologi	96					
4.	https://www.ince	usa.org/publicat	ions/noise-r	news-inte	rnationa	ı			
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S	WAYAM/NPTEL/N	100Cs:		· / ·					
1.	https://nptel.ac.ir	n/courses/11210	7212 (Introd	luction to	Mechar	nical Vibra	tion)		
2.	https://www.class	scentral.com/co	urse/swayan	n-sound-a	and-struc	ctural-vibr	ation-58554		
3.	https://onlinecou	rses.nptel.ac.in/	noc22_me34	1/preview	v (Sound	and Struc	tural Vibrati	on)	
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	Course Code	B20ER0706	Credits	:	1	Cl	ass	VII Se	emester
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CO	OURSE OVERVIEW	falsis late to the	ا بالمساسية	lambe ! !	, all or	الماسية		lavaletti	المالية المالية
Th	ne main purpose o	r this iab is to tr	ain the stud	ents indu	ustry rea	ay and to	attain empl	oyability s	kills with the
Cr	ve programming o	i canned cycles a	and cutting t	ooi patn	generati	on through	II CINC SIMUI	ation SOTTV	vare by using
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Re	Journal of Sound a Journal of Vibration Https://www.scienthtps://www.scienthtps://ink.spring WAYAM/NPTEL/N https://nptel.ac.ir https://onlinecounthttps://onlinecounthttps://onlinecounthttps://nptel.ac.ir Course Title Course Code Course Title Course Code Course Structure OURSE OVERVIEW The main purpose of NC programming of the Bos/SME/BME-2020	0-21-20.06.20/2021-	22-05.06.21/20	122-23-25.0	0.22/2023	-24-10.00.23			

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G-Codes an	d M-cc	odes. S	Studen	ts will	get acc	quaint	ed abc	out CNO	C Lathe	part p	orogran	nming	for Turni	ing, F	acing,
Grooving, S	tep tur	ning, ⁻	Taper	turning	, Circul	ar inte	erpolat	ion, Co	mbina	tion of	few o	peratio	ns follow	ved b	y CNC
Mill Part pr	ogramı	ming f	or Dril	lling, Pe	eck drill	ling, B	oring,	Turnin	g, Faciı	ng, Tap	er turr	ning. T	he course	e trair	ns the
COURSE OB	i appiyi S JECTIV	ng ma ' ES	cnine	learnin	g techn	iques	using t	ушоп	וטו נטנ	n me n	ionitori	ng.			
1. To train t	he stuc	dents v	vith Cl	NC part	progra	mmin	g conc	epts							
2. To genera	ate mai	nual p	art pro	gramm	ning – C	NC Tu	rning,	milling	and dr	illing					
3. To familia	arize wi	ith the	variou	us oper	ations t	to be p	perforr	ned wi	th synt	ax forn	nat bas	ed on	Fanuc cor	ntrolle	er.
5. To familia	arize wi	ith the	variot	us Macl	hine Lea	given	Mode	ls for t	ool cor	opera	monito	voived oring.	1 III IL.		
COURSE OL	тсом	ES (CC	s)				•					J			
After the co	mpleti	on of t	he cou	urse, th	e stude	ent wil	l be ab	le to:							
СО	•			-	Cours	e Out	comes		-	-	-		POs	P	SOs
CO1 Unde	erstand	l the	basic	concep	t of N	C pro	gramn	ning la	nguage	es – N	1anual	Part	1,2,5	:	1,2
prog Anal	vze the	yario	us one	eration	s involv	part p	the pr	ofile 14	ith its	syntav	forma	t for		-	
CO2 mach	nining a	and do	cumer	nt the r	esultș⁄i	n the	form o	f techn	ical rep	ort.	· · Jiiiia	: 101	1,2,5,9,10) :	1,2
Gene	erate th	ne par	t prog	ram for	the gi	ven tu	irning,	drilling	g and N	Ailling	profile/	/part	1 2 5 0 10	, _	1 7
geon	netry a	nd doo	cumen	t the re	sults in	the f	orm of	techni	cal rep	ort		-	1,2,3,3,10	<u> </u>	1,2
CO4 Use	Canne	d Cycle	es for D	Orilling,	Peck dr	rilling,	Boring	, Turni	ng, Tap	er turr	ning, Th	read	1,2,5,9,10) :	1,2
Fami	ng ope	with	the c	ompute	ent the	erical	contr	ol soft	ware	and it	s abilit	v to			
CO5 gene	rate th	e cutt	er tool	path a	s per gi	ven p	rofile ii	the d	ry run	and do	cumen	t the	1,2,5,9,10) :	1,2
resul	lts in th	e form	of te	chnical	report.										
CO6 App	ly Mac	hine(L	earnin	g Mode	els for t	ool co	nditio	n moni	toring	using P	ython.	<u> </u>	1,2,5,9,10) [1,2
BLOOM'S LI	EVELOF	FTHEC	OURS	E OUTC	OMES			oom's	Laval	$/ \langle$					
	1						DI	OOTH S	re AGI _						
со	Re	memh	er	Under	rstand	(VlaaA		Anal	vze	Ev	aluate		Create	e
со	Re	memb	er	Under (L	rstand 2)		Apply (L3)		Anal	yze 1)	Ev	aluate (L5)	: (Create (L6)	е
CO1	Re	memb	er	Under (L	rstand 2)		Apply (L3)		Anal (L4	yze 1)	Ev	aluate (L5)	. (Creat (L6)	e
CO1 CO2	Re	ememb (L1)	per	Under (L	rstand 2) /		Apply (L3)		Anal (L4	yze 1)	Ev	aluate (L5)	. (Creato (L6)	e
CO1 CO2 CO3	Re	ememb (L1)	per	Under (L	rstand 2)		Apply (L3)		Anal (L4	yze 1)	Ev	aluate (L5)	. (Creato (L6)	e
CO1 CO2 CO3 CO4	Re	memb	per	Under (L	rstand 2)		Apply (L3)		Anal (L4	yze	Ev	aluate (L5)		Creat (L6)	e
CO1 CO2 CO3 CO4 CO5	Re	ememb	per	Under (L	rstand 2) /		Apply (L3)		Anal (L4	lyze	Ev	aluate (L5)		Create (L6)	e
CO1 CO2 CO3 CO4 CO5 CO6	Re	ememb	MATR	Under (L	rstand 2)		Apply (L3)		Anal (L4	lyze	Ev	aluate (L5)		Creato (L6)	e
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR	Re	L1)	MATR	Under (L	rstand 2)		Apply (L3)		Anal (L4	lyze	Ev Ev	aluate (L5)	. (Creati (L6)	e m
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR	TICULA	ATION	MATR	SIX Control of the co	rstand 2) /	904	Apply (L3)	808	Anal (L4	yze 1) 010d	PO11	aluate (L5)	PSO1	Creat(L6)	e EOSA
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1	TICULA 3	ATION 20 2	MATR	SIX (L)	rstand 2) /	90d	Apply (L3)	808	Anal (L4	yze 1) 010d	PO11	aluate (L5)	2 2 2	Creat (L6)	e EOSd
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2	TICULA TO 3 2	ATION 2 3	MATR	SIX 400	50d 1 3	900	Apply (L3)	800	Anal (L4	010 <u>0</u>	PO11	6012 (L5)	5 6 7 8 9 9 9 9 9 9 9 9 9 9	Create (L6)	e EOSd
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3	TICULA 3 2 2 2	ATION 20 2 3 3 3 2	MATR	SIX POD	SQ 1 3 3 3 2	900	Apply (L3)	808	Anal (L4	010d 2 2	PO11	Aluate (L5)	10SE 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Creat(L6)	e BSO3
CO CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5	TICULA 3 2 2 2 2	ATION 20 2 3 3 3 3 3 3 3	MATR	SIX 400 CITY OF THE PROPERTY O	(stand 2) / (SO 2 1 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	90d	Apply (L3)	80d	Anal (L4	910d 2 2 2 2	PO11	Aluate (L5)	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Creat(L6) 20 1 2 2 2	e SO3
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6	TICULA 10 3 2 2 2 2 3	2 3 3 3 2	MATR	SIX POOL	500 1 3 3 3 1	900	Apply (L3)	800	Anal (L4	0100 2 2 2 2 2 1	PO11	Aluate (L5)	705 2 2 2 2 2 2 2 2	Create (L6) 1 2 2 2 1	e EOSd
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average	TICULA 3 2 2 2 3 2.3	2 3 3 3 2 2.6	MATR	SIX 400 Under	ST	90d	Apply (L3)	800	Anal (L4)	9FOA 2 2 2 2 1 1.8	PO11	Aluate (L5)	2 2 2 2 2 2 2 2	Create (L6) 20 1 2 2 1 1.6	e SO34
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	TICULA 3 2 2 2 3 2.3 v, 2-Me	ATION 20 2 3 3 3 2 2.6 edium,	MATR © 3-Higl	AND TO THE PROPERTY OF THE PRO	S Q 1 3 3 3 3 1 2.3	90d	Apply (L3)	80d	Anal (L4)	97 02 2 2 2 2 1 1.8	PO11	Aluate (L5)	2 2 2 2 2 2 2 2	Create (L6) 1 2 2 2 1 1.6	e SOSA
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	TICULA 10 3 2 2 2 3 2.3 v, 2-Me	2 3 3 3 2 2.6 edium,	MATR ©Q 3-High	Under (L	500 1 3 3 3 1 2.3	900	Apply (L3)	8004	Anal (L4)	2 2 2 2 1 1.8	PO11	aluate (L5)	705 2 2 2 2 2 2 2 2 2	Create (L6) 1 2 2 2 1 1.6	e EOSd
CO1 CO2 CO3 CO4 CO5 CO6 COURSE AR CO/ POs CO1 CO2 CO3 CO4 CO5 CO6 Average Note: 1-Lov	TICULA 3 2 2 2 3 2.3 v, 2-Me	2 3 3 3 2 2.6 edium,	MATR © 3-Higl	D TO	ST	900	Apply (L3)	800	Anal (L4)	9FOQ 2 2 2 2 1 1.8	PO11	ZTOd	2 2 2 2 2 2 2 1	Create (L6) 1 2 2 2 1 1.6	e SO3d
G-Codes an Grooving, S Mill Part pristudents on COURSE OB 1. To train to 2. To genera 3. To familia 4. To carry of 5. To familia 6. To course OL After the cool cool program and course out a geometric cool generated by the cool cool cool cool cool cool cool coo	TICULA 3 2 2 2 3 2.3 v, 2-Me	ATION 2 3 3 3 2 2.6 edium,	MATR © 3-Higl	HX 700	Stand (2) / SO 1 3 3 3 1 2.3	90d	Apply (L3)	80 Q	Anal (L4)	9TOA 2 2 2 2 1 1.8	PO11	Aluate (L5)	2 2 2 2 2 2 2 2	Create (L6) 1 2 2 2 1 1.6	e EOSA

			Bloom	's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		< < <	> /			
CO2				\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		
CO3			/			
CO4			/			
CO5			$\langle \checkmark \rangle$			
CO6				✓		

CO/ POs	PO1	PO2	PO3	PO4	PO5	90d	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02	PSO3
CO1	3	2			1								2	1	
CO2	2	3			3				2	2			2	2	
CO3	2	3			3				2	2			2	2	
CO4	2	3			3				2	2			2	2	
CO5	2	3			3				2	2			2	2	
CO6	3	2			1				1	1			2	1	
Average	2.3	2.6			2.3				1.8	1.8			2	1.6	

Part-A

- 1. Manual CNC part programming for turning and drilling parts. Selection and assignment of tools, correction of syntax and logical errors, and verification of tool path.
- 2. Simulation of Turning, Drilling operations. Typical simulations to be carried out using simulation packages like: Cadem CAMLab-Pro, Master- CAM with and without canned cycle programs.
- 3. Simulation of Milling operations. Typical simulations to be carried out using simulation packages like: Cadem, CAMLab-Pro, Master- CAM, M-Tab for with & without canned cycle programs

Part-B

- 1. Introduction to Machine Learning Techniques and implementation using Python.
- 2. Supervising of data acquired from CNC Machining.
- 3. Prediction of tool wear using Machine Learning Models.

TEXT BOOKS

- 1. M.P.Groover & Emory W.Zimmer, "CAD/CAM, Computer Aided Design and Manufacturing", Pearson India, 2nd Edition. 2007.
- 2. Mikell P.Groover, "Automation, Production system & Computer Integrated Manufacturing", Pearson India, 2nd edition. 2007.
- 3. Tom Mitchell, "Machine Learning", McGraw-Hill, 2nd Edition 2017.

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- 1. Ibrahim Zeid, "CAD/CAM theory and practice", Tata McGraw hill. 2007.
- 2. P. Radha Krishnan, S. Subramanyan & V. Raju, "CAD/CAM/CIM", New Age international Publishers, 2nd Edition. 2008.
- 3. P. Radha Krishnan, "Computer Numerical Control Machines and CAM", New Age international Publishers, 1st Edition 2012.

- 4. P. N. Rao, "CAD/CAM Principles and applications", Tata McGraw hill, 2010.
- 5. Chris Bishop, "Neural Networks for Pattern Recognition", Oxford University Press, 1995

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- 1. https://www.sciencedirect.com/journal/Computer Aided Design
- 2. https://www.sciencedirect.com/journal/Advancements in CAD/CAM technology: Options for practical implementation

SWAYAM/NPTEL/MOOCs:

- 1. https://nptel.ac.in/courses/112102102
- 2. https://nptel.ac.in/courses/112104289

Course Title	Total Quality	Managemei	nt and Six	Sigma	Cours	se Туре	Open	Elective
Course Code	B20MEO801	Credits	3	3	С	lass	VIII se	emester
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	ILF	Credits	Hours	Load	Cla	isses		ghtage
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	Tutorial	0	0	0	Theory	riactical	IA	SEE
	Total	3	3	3	39	0	50 %	50 %

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Course Code	TLP	Credits Credits	Contact	Work	Total N	umber of	Assessi	mester ment in
			Hours	Load	Cla	isses	Weig	htage
Course	Theory	3	3	3	Per Se	emester	<u>-</u>	
Structure	Practice	0	0	0	Theory	Practical	IA	SEE
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COLIBEE OVERVIEW	iotai	3	3	3	39	U	50 %	50 %
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contributions of qua	lity gurus to th	ne developme	ent of TQ	M. Tech	niques and	d tools whic	h Focus on	customer
satisfaction and thei	r involvement	in the TQM p	orogram a	re inclu	ded .The d	course prese	nts various	tools and
techniques which are	e widely used in	continuous ii	mprovem	ent (CI) a	nd TQM ir	mplementati	on progran	ns. Various
quality management	tools, six sigm	a methodolog	gy (DMAIC) and de	sign for six	k sigma (DFS	s) techniqu	es are also
COLLEGE OF LECTIVES	urse.							
1 To provide the kno	owledge of aug	lity and its ov	olution					
2. To provide the KIIC	pasics of leader	ship and custo	omer ner	ception (of quality			
3. To impart the know	wledge of qual	ity tools		seption (quanty			
4. To attain the know	vledge of six sig	ma and its m	ethodolo	gy				
COURSE OUTCOMES	(COs)							
After the completion	of the course,	the student	will be ab	le to:				
со		Course O	utcomes	<u> </u>	<u> </u>		POs	PSOs
CO1 Describe the principles can	principles of t	otal quality r	nanagem anageme	ent and	to explai	n how these	1,2	1,2,3
CO2 Explore the va	arious dimension	ons of custom	er satisfa	ction and	their inv	olvement	1,2	1,2,3
CO3 Use appropria	ate process im	provement to	echnique	s for me	asuring ar	nd improving	1,2	1,2,3
CO4 Select approp	oriate statistica es in quality ma	techniques f	for impro	ving pro	cesses and	d analyze the	1,2,5	1,2,3
CO5 Analyze and a	pply six sigma	methodology	for desig	n optimi	zation of p	rocess.	1,2,3,5	1,2,3
CO6 Use simulatio	n tools to enha	nce the proce	ess capab	ility.			1,2,5	1,2,3
BLOOM'S LEVELOF T	HECOURSE OU	TCOMES						
			Blo	oom's Le	vel			
CO	ember Und	derstand	Apply		Analyze	Evalua	ate	Create
(1	L1)	(L2)	(L3)		(L4)	(L5)		(L6)
CO1			√					
CO2			✓					
CO3					✓			
CO4			✓					
CO5			\checkmark					
CO6		T			✓			
Course Title Course Code Course Structure COURSE OVERVIEW The course offers for insights into basic a contributions of qualisty management relaborated in this coordinated in this coordinated in this coordinated in this coordinated in the known of the course of the known of the kn	,	1		·		•	1	

			Bloom	ı's Level		
со	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			✓			
CO3				✓		
CO4			√			
CO5			√			
CO6				✓		

COURSE ARTICULATIONMATRIX

CO/ POs	PO1	P02	PO3	PO4	PO5	P06	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02	PSO3
CO1	3	2	1										3	1	1
CO2	3	2	1										3	1	1
CO3	3	3											3	1	1
CO4	3	1											3	1	1
CO5	3	2	1										3	1	1
CO6	3	3	1										3	1	1
Average	3	2.2	1										3	1	1

Note: 1-Low, 2-Medium, 3-High

COURSE CONTENT

Unit-1

Principles and Practices: Basic approach, gurus of TQM, TQM frame work, awareness, defining quality, historical review, obstacles, benefits of TQM.

Leadership: Definition, characteristics of quality leaders, leadership concepts, Deming philosophy, role of TQM leaders, implementation, strategic planning communication

Unit-2

Customer Satisfaction and Customer Involvement: Perception of quality, feedback using customer complaints, service quality, translating needs into Requirements, Kano model, customer retention. Employee involvement - Motivation, employee surveys, Empowerment teams, suggestion system, recognition and reward, gain sharing, performance appraisal

/Unit-3

Continuous Process Improvement: Juran triology, improvement strategies, PDCA cycle, problem solving methods, Kaizen, 5S concepts, six sigma. Tool and Techniques - Statistical process control-7QC tools, Benching marking, information technology, quality management systems, QFD, FMEA, product liability, Total productive maintenance. TQMEX model.

Unit-4

Quality Management Tools: Forced filed analysis, nominal group techniques, affinity diagram, interrelationship digraph, tree diagram, matrix diagram, process decision program chart and activity network diagram.

Design for Six Sigma: Introduction to DMAIC approach and DFSS, tools for concept development, design development, design optimization and design verification problems.

TEXT BOOKS

- 1. Dale H.Bester field, "Total quality Management", Pearson Education India, ISBN: 8129702606.
- 2. M.Zairi, "Total quality Management for Engineers", 3rd Edition, McGraw-Hill's, 1987.

REFERENCE BOOKS

- 1. Shoji shiba, Aln Graham, David Walden, "A new American TQM, four revolutions in Management", Productivity Press, Orgeon, 1990.
- 2. Gopal K.Kanji and Mike Asher, "100 Methods for TQM", Sage Publications, Inc., 1st Edition.
- 3. H.Lal, "Organizational Excellence through TQM" New age Publication.

JOURNALS/MAGAZINES

- 1. https://www.emerald.com/insight/publication/issn/0265-671X International journal of quality and Reliability Management
- 2. https://www.emerald.com/insight/publication/issn/2040-4166---- internal journal of six sigma

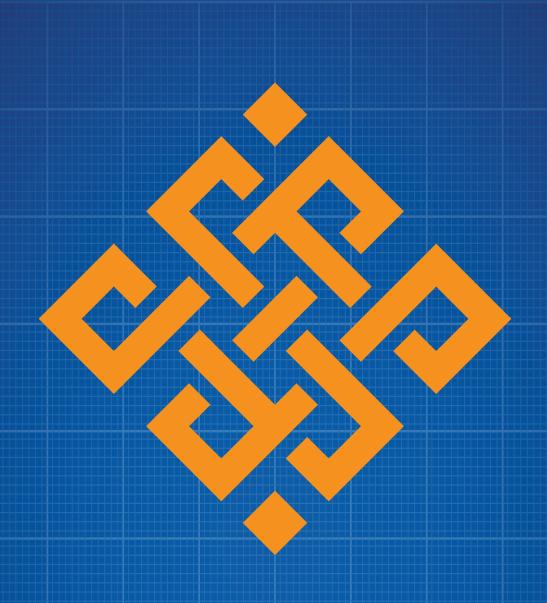
SWAYAM/NPTEL/MOOCs:

- 1. https://onlinecourses.nptel.ac.in/noc21 mg03/preview
- 2. https://nptel.ac.in/courses/110104085

Course Title	Major Project			Course Type	Hard Core	
Course Code	B20ER0801	Credits	6	Class	VIII Semester	
Course Structure	TLP	Credits	Contact Hours	Assessment in		
	Theory	0	0	Weightage		
	Practice	6	18	IA	SEE	
	Tutorial	0	0	IA		
	Total	6	18	50 %	50 %	

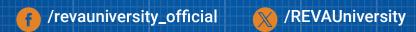
Course Title		Maior Pr	oiect		Course	Type	Hard Co	re
Course Code	B20ER0801	Credi	ts	6	Cla	iss	VIII Seme	ster
	TLP	Credi	ts Contac	t Hours		Assessm	ent in	
	Theory	Theory 0 0 Weightag					tage	
Course	Practice	6	1	8				
Structure	Tutorial	0	()	14	4	SEE	
	Total	6	1	8	50	%	50 %	
COURSE OVERVIEW	I							
to work on an oper different courses an to the find solution to the attribute of graduat COURSE OBJECTIVE	n ended engine nd training, whi he stated probl ce engineers.	ering proble ch they have em. It also e	em. Typically e studied in tl emphasizes th	the stud neir curric	ents wou ulum usin ance of life	ld apply knov g methods, t e-long learnin	with an opp wledge gair ools and tea ng as a func	ned from chniques lamenta
provide a det problem related. To develop a mul To provide an exparrive at meani COURSE OUTCOME	tinite circumstand to society. tidisciplinary apposure to take ungful conclusions (COs) n of the course	pproach for up a real life ns / product	problem solv research pro t design / solv t will be able	ing. blem, pro ution. to:	duct deve	ourses of the	program a lustrial prob	nd solve
со	^	Cou	rse Outcome	s			POs	PSOs
CO1 Articulate	iculate problem statements for real life problems with suitable assumptions and						and 1	1,2,3
CO2 Perform lit	erature search	and / or pat	ent search in	the area	of interes	t.	2, 12	1,2,3
Design solu CO3 processes	Title Major Project Course Type Hard Core Tode B20ER0801 Credits 6 Class VIII Semester TLP Credits Contact Hours Assessment in Weightage Practice 6 18 IA SEE Tutorial 0 0 0 Total 6 18 50 % 50 % VERVIEW In introduces the students to professional engineering practice by providing them with an opportunity in an open ended engineering problem. Typically, the students would apply knowledge gained from ourses and training, which they have studied in their curriculum using methods, tools and techniques uition to the stated problem. It also emphasizes the importance of life-long learning as a fundamental of graduate engineers. BJECTIVES idea a definite circumstances, to apply the leanings from various courses of the program and solve immelated to society. Iop a multidisciplinary approach for problem solving. Idea an exposure to take up a real life research problem, product development, industrial problem and at meaningful conclusions / product design / solution. UTCOMES (COS) completion of the course, the student will be able to: Course Outcomes POS PSOs rticulate problem statements for real life problems with suitable assumptions and sonstraints. 1 1,2,3 esign solutions for complex engineering problems and design system components or rocesses that meet the specified needs or understanding the social, environmental 3, 6, 7 1,2,3 and in economic contexts.							
and in ecor CO4 Analyze da	nd in economic contexts. nalyze data and reach a valid scientific conclusion or product or solution. 4 1,2,3							
Apply appro CO5 complex er practice.	Title Major Project Course Type Hard Core							
CO6 Function e settings.	tion effectively as a member or leader in diverse teams and in multidisciplinary 9 1,2,3							
CO7 Write effect	tive reports, de	esign docum	entation and	make eff	ective pre	sentations.	10	1,2,3
CO8 Demonstra principles t	nonstrate knowledge and understanding of the engineering and management ciples to manage projects.							
BLOOM'S LEVEL OF	THE COURSE C	UTCOMES	= •	,	1			
Bloom's Level						C	ato	
Ken	(L1)	(L2)	(L3)	An	L4)	Evaluate (L5)	(I	.6)
CO1		• •	√			· - /		•
CO2					٧			
	3				٧			
CO3					٧			
CO3 CO4						√		
CO3 CO4 CO5								
CO3 CO4 CO5 CO6		٧						

	Bloom's Level								
СО	Remember	Understand	Apply	Analyze	Evaluate	Create			
	(L1)	(L2)	(L3)	(L4)	(L5)	(L6)			
CO1			٧						
CO2				٧					
CO3						٧			
CO4				٧					
CO5					٧				
CO6		٧							
CO7				٧					



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