REVA UNIVERSITY
Bengaluru, India

SCHOOL OF MECHANICAL ENGINEERING

B.Tech

in

Mechanical Engineering

HAND BOOK

2014-18

Rukmini Knowledge Paík
Kattigenahalli, Yelahanka, Bengaluíu – 560064
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REVA UNIVERSITY
Bengaluru, India

School of Mechanical Engineering

Scheme of Instruction and Curriculum of 1st to 8th Semester

Hand Book

2014-15

Approved

By

Board of Studies

BOS/ME/BME/2014-15/01/01.02-2014

BOS/ME/BME/2015-16/02/30-04-2015

For

B.Tech. in Mechanical Engineering (2014 admitted)

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H N'BLE CHANCELLOR MESSAGE

P. Shyama Raju
Chancellor
REVA University

Education during recent years has witnessed a great transformation. Today's society, termed as "Knowledge Society" has brought about unprecedented economic and social growth. This has propelled universities across the world to devise new ways of tapping human potential for different competencies and building a vibrant society with a win-win situation for all.

REVA University has seen the light of the day to imbibe this character of paradigm shift in academic pursuits to contribute to the knowledge society. REVA works hard to bring in you an exciting and rewarding educational experience, to discover new interests and to develop your career prospects. You will benefit from a unique approach to student-centered learning through group work and individual study tackling real world challenges alongside experienced practitioners and researchers.

REVA has excellent learning facilities including custom built teaching facilities designed specifically to emulate working conditions, air-conditioned library opened for your studies from early morning till midnight and facilities for variety of sports and cultural activities.

Our faculties have introduced socially relevant and market driven commerce courses after studying the market situation in detail and consulting entrepreneurs, experts in different areas of commerce and industry and other stake-holders. I am glad that the Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) being adopted will facilitate learning environment under continuous guidance and monitoring by the faculty and equip you with competent skills apt for different job prospects across the global.

I hope that the present scheme of instructions, continuous periodic progress assessments, course curriculum of B.Tech in Mechanical Engineering program and other information provided in this hand book will guide you to choose appropriate courses of study and move ahead in the right direction in your chosen area of study. I hope you will enjoy and experience the curriculum, the student-centered teaching and learning ambience in developing your personality to become successful professionals, entrepreneurs and proud citizens of the country.

I wish you every success in your career.

PREFACE

Higher education across the globe is opening doors of its academic disciplines to the real world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

The B.Tech in Mechanical Engineering program is designed keeping in view the current situation and possible future developments, both at national and global levels. The courses being offered give greater emphasis on core Mechanical Engineering and its related areas of study. These are termed as Hard Core courses. There are ample number of courses providing knowledge in specialized areas facilitating students to choose specialized areas of their interest. Some of these areas include: strength of materials, thermodynamics, fluid mechanics, turbo machinery, theory of machines, designing, finite element analysis, manufacturing, CAD/ CAM/CAE, operation research, production, heat and mass transfer, tribology, cryogenics, automobile engineering, renewable energy sources, refrigeration and air conditioning, total quality management, product design and development, non destructive testing, robotics, rapid prototyping, hydraulics and pneumatics, sensors, mechatronics, MEMS, nanotechnology, collaborative and digital manufacturing and so on. Adequate attention is given on the study of various modern tools, techniques and strategies being used. Knowledge on application of these tools in practice and strategies for effective planning, designing, analysis and manufacturing of today's modern goods and services in an most economic way form part of the study.

The projects in the area of advanced and recent trends in mechanical engineering, production, aerospace, CAD/CAM/CAE and robotics are part of the program and these will certainly provide students the experience of practical exposure in working environment.

The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society.

Our well qualified, experienced and committed faculty will guide you, monitor your progress, mould you and make your study interesting and fruitful. The facilities for curricular and co-curricular activities with dedicated supportive staff provide you conducive ambiance for learning.

This handy document containing a brief information about B.Tech in Mechanical Engineering program, the scheme of instruction, course content, CBCS-CAGP regulations and its advantages and calendar of events for the year will serve as a guiding path to students to move forward in a right direction. It would definitely mould them with knowledge, skill and ethical values to face the challenges of this competitive world with greater confidence in becoming proud citizens of mother India.

Prof. V.G.Talawar
Vice-Chancellor
REVA University

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RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama 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. The Rukmini Educational Charitable Trust (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Commerce, Education, Engineering, Environmental Science, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies,(RIMS) REVA Institute of Education,(RIE) REVA First Grade College,(RFGC) REVA Degree College (Evening), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Engineering, Commerce, Management, Education, Arts and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Sri. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Shri. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to M. Phil and Ph.D degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 9,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University established under the Government of Karnataka Act 80 of the year 2012 and notified in the Karnataka Gazette dated 7th Feb, 2013, is located 14 kms away from the Bangalore International Airport on the way to Bangalore city. The university has a sprawling lush green campus spread over 35 acres of land equipped with state-of-the-art infrastructure and conducive environment for higher learning.

The REVA campus has well equipped laboratories, custom-built teaching facilities designed specifically to emulate working conditions, fully air-conditioned library and central computer centre kept open from morning 8.00 AM till mid-night for the students and the faculty. The well planned sports facility for variety of sports activities, facilities for cultural programs and friendly campus lifestyle add to the overall personality development of students. The campus also has residential facility for students, faculty and staff.

Currently, REVA University offers 18 Post Graduate programs and 8 Graduate programs in Engineering and Technology, Science, Commerce and Management in addition to research degrees leading to Ph.D in

different disciplines. The University aims to offer many more PG and UG programs in Science, Arts, Commerce, Engineering & Technology, Management Studies, Education, in the years to come.

The programs being offered by REVA University are well planned and designed after detailed study in emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Grading Pattern (CBCS – CAGP) of education has been 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. The system also allows students to move forward under fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

ABOUT SCHOOL OF MECHANCIAL ENGINEERING

Mechanical Engineering, one of the classical branches of engineering, has undergone significant transformation in recent years to measure up to the challenges in the modern world. It plays an increasingly leading role in industries that depend on high and innovative technologies such as space, automotive, defense, marine, medicine and food production. The school of Mechanical Engineering of the REVA University is headed by a dedicated and experienced Professor of Mechanical Engineering and is supported by well qualified faculty members. The school has the state-of-the-art class rooms and well equipped laboratories. The school offers B. Tech and M. Tech programs. It also has research program leading to Doctoral degree. The curriculum of both graduate and post graduate degree programs have been designed to meet the needs of the present and future mechanical engineers. It attempts to bridge the gap between academia and industries. The B.Tech program aims to prepare human resource to play a leading role in products and processes that present solutions to problems faced by the industry and society. The Master's Degree program in Machine Design and Dynamics focuses on the core and advanced applications for mechanical engineers to monitor and manage the changing conditions. The students undertaking this program strive to create engineering solutions for a cleaner, healthier, safer, quality and sustainable world.

VISION OF THE SCHOOL OF MECHANICAL ENGINEERING

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

MISSION

1. To impart quality education to the students and enhance their skills to make them globally competitive mechanical engineers.
2. To promote multidisciplinary study and cutting edge research and expand the frontiers of mechanical engineers profession.
3. To create state-of-art facilities with advanced technology for providing students and faculty with opportunities for innovation, application and dissemination of knowledge.
4. To prepare for critical uncertainties ahead for mechanical engineering and to face the challenges through clean, green and healthy solution.
5. 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.

ACADEMIC OBJECTIVES

1. To prepare graduates and post graduates in Mechanical Engineering who will excel in their professional career and contribute with commitment and dedication to the progress of the society and the nation.
2. To conduct cutting edge research of social relevance leading to Ph D, M Phil and Post Doctoral Degrees in Mechanical Engineering.
3. To promote faculty, researchers and students to participate in National and International conferences, seminars, workshops for shareing their exprience and to disseminate through publishing in journals of repute, books and patents for benefit of the society at large.
4. To organize conferences, seminars, workshops, special lecturers, summer schools, technical talk, faculty development program etc., on emerging areas.
5. To establish incubation center and center of excellence in thrust areas in collaboration with industries.
6. To organize and promote co-curricular and extracurricular activities that inculcate among students concern to the society,
7. To undertake funded research projects from both at National and International funding agencies and carry out research that will contribute for the progress of the Industries, Society and Country as a whole.
8. To have extensive collaboration with sister schools within the university and other institutions, industries, universities, voluntary organization and such other to carry on research, extension and training programs.
9. To evolve newer methods and techniques in teching and learning and produce modular lessons useful not only to the students of REVA University but also others.

Advisory Board

Sl.No.	Name of Members
1	**Dr. K. Balaveera Reddy** Former Vice Chancellor, VTU.
2	**M.P. Ravindra** President IUCEE, Bangalore.
3	**Prof. N Siva Prasad** Professor Dept. Mechincal Enginreering IIT Chennai, Madras.

CBCS (CHOICE BASED CREDIT SYSTEM) AND CAGP (CONTINUOUS ASSESSMENT AND GRADING PATTERN) OF EDUCATION AND ITS ADVANTAGES

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Degree / Masters Degree program. It is more focused towards the student's choice in providing a wide range of modules available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher-student participation.

Studying under CBCS has following advantages:

- Students may undergo training in cross-disciplinary and multi-disciplinary subjects and acquire more focused and preferred knowledge.
- Students may get more skills from other subject(s) which are required for the career path in addition to their regular subject knowledge.
- Students may get ample opportunities to use the laboratories and gain practical exposure to the much needed modules available in other departments/schools for want of scientific inputs.
- Courses are conducted by subject experts identified on the basis of their experiences. Courses taught by such experts may provide in-depth information and clear understanding of the modules.
- Students may get an opportunity to study courses with other students of different programs and exchange their views and knowledge in a common class room.
- CBCS provides a cross-cultural learning environment.
- Students may benefit much from selecting the right options to successfully face the public service examinations like UPSC, KPSC, IFS, IES wherein the knowledge of additional subjects become mandatory for general or optional papers.
- Students are exposed to the culture of universal brotherhood during their campus life.
- Students are allowed to practice various methods of learning a subject.

BRIEF OUTLINE OF REVA UNIVERSITY REGULATIONS FOR CHOICE BASED CREDIT SYSTEM (CBCS) AND CONTINUOUS ASSESSMENT GRADING PATTERN (CAGP) FOR DEGREE PROGRAMS IN COMMERCE AND MANAGEMENT STUDIES, 2013

The teaching and learning process under CBCS-CAGP of education in each course of study will have three components, namely-

(i) L= Lecture (ii) T= Tutorial (iii) P= Practice, where:

L stands for **Lecture** session consisting of classroom instruction.

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

P stands for **Practice** session and it consists of hands- on experience / laboratory experiments / field studies / case studies that equip students to acquire the much required skill component.

Each of the courses carries credits which are based on the number of hours of teaching and learning. In terms of credits, every one hour session of L amounts to 1 credit per semester and a minimum of two hour session

of T or P amounts to 1 credit per semester, over a period of one semester of 16 weeks for teaching-learning process. The total duration of a semester is 20 weeks inclusive of semester-end examination. The number of credits to be earned by the candidates for successful completion of a given program may vary from program to program. For example, one has to earn a minimum of 176 credits for successful completion of 4 year B. Tech program.

Various **Courses of Study under CBCS-CAGP of education** are labeled and defined as: (i) Core Course (CC), (ii) Hard Core (HC), (iii) Soft Core (SC), (iv) Foundation Course (FC), and (v) Open Elective (OE) courses.

(i) Core Course:

A course which has to be studied by the candidates as a core-requirement is termed as Core Course. The CORE courses of Study are also grouped as: (i) Hard Core Course, and (ii) Soft Core Course.

(ii) Hard Core Course:

The Hard Core Course is a Core Course in the main discipline / subject of study that the candidates have to study compulsorily. These courses cannot be substituted by any other course(s) and are fundamental requirements for a subject of study.

(iii) Soft Core Course:

Soft Core courses are pool of courses from the main discipline and are slightly advanced areas of study. Every school / department of study of the University will furnish a detailed list of need-based Soft Core courses and students can choose one/two or many of them depending upon the program structure. The Soft Core course provides enough scope for advanced learning in a subject within or outside the school /department.

(iv)Foundation Course:

Certain areas of study such as environmental studies, Indian constitution, disaster management, etc. are required to be studied by all the students. These are the mandatory courses prescribed by the government/university. Hence these course are labeled and defined as foundation courses.

(v) Open Elective Course:

Open Elective courses are the concept courses and offered by each school/ department. These courses are general in nature and students have the freedom to choose any of them. These are chosen generally from other discipline(s) / subject(s) of study with an intension to seek exposure to other areas of study.

(vi)Self Study Elective Course:

An elective course designed to acquire a special/advanced knowledge, such as supplement study/ support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher is called a Self Study Elective.

Project work/Dissertation:

Project work/Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem.

(i) Minor Project:

A project work up to FOUR credits is called Minor Project work.

(ii) Major Project:

A project work of SIX or EIGHT credits is called Major Project work.

(iii)Dissertation:

Dissertation work can be of **TEN** or **TWELVE** or **SIXTEEN** credits. **A Project/Dissertation work may be a hard core or a soft core as decided by the Board of Studies concerned.**

Duration of the program and Medium of Instruction:

B.Tech degree program is of 8 semesters - 4 years duration of 176 credits. A candidate can avail a maximum of 16 semesters - 8 years as per double duration norm, in one stretch to complete B Tech degree, including blank semesters, if any. Whenever a candidate opts for blank semesters, he / she has to study the prevailing courses offered by the School / Department when he / she resumes his / her studies.

A candidate can exercise an option to exit with Advanced Diploma in Engineering & Technology (ADET) by completing 132 credits as stipulated in the corresponding first six semesters of B Tech. A candidate can avail in one stretch at most 12 semesters to exit with Advanced Diploma in Engineering & Technology (ADET) subject to conditions as mentioned above.

A candidate has to earn 176 credits for successful completion of B Tech degree with the distribution of credits for different courses as given in **Table 1** below.

Course Type	Credits	
	For B Tech Degree (8 Semesters)	For option to exit with Advanced Diploma in Engineering & Technology (ADET) (6 Semesters)
Foundation Core Course	A minimum of 06	A minimum of 06
Hard Core Course	A minimum of 100, but not exceeding 112	A minimum of 72, but not exceeding 88
Soft Core Course	A minimum of 48	A minimum of 32
Open Elective	A minimum of 04	A minimum of 04
Total	**176**	**132**

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.

Sl. No.	Course Title	Number of Credits
1	Communication and Technical documentation	4
2	Environmental Science	2
3	Indian Constitution	2

A candidate can enroll for a maximum of 28 credits per Semester including:

(i)**Dropped Courses** of corresponding semester(s) of previous year(s), if any:

(ii)**Additional Courses** from the corresponding Semester of immediate succeeding year. However, a candidate may not successfully earn a maximum of 24 credits per semester.

Generally a full-time candidate may register for 20 credits per semester.

The medium of instruction shall be English.

Eligibility for Declaration of Ranks / Medals:

Only such candidates who register for a minimum of 16 credits per semester from I semester to VIII semester and complete successfully 176 credits in 8 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

Add- on Proficiency Certification:

In excess to the minimum of 176 credits for the B.Tech Degree program, a candidate can opt to complete a minimum of 4 extra credits either in the same discipline/subject or in different discipline / subject to acquire **Add on Proficiency Certification** in that particular discipline / subject along with the B.Tech degree.

Add on Proficiency Diploma:

In excess to the minimum of 176 credits for the B.Tech degree program, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline/subject or in different discipline / subject to acquire Add on Proficiency Diploma in that particular discipline / subject along with the B.Tech degree.

The add on Proficiency Certification / Diploma so issued to the candidate contains the courses studied and grades earned.

Continuous Assessment, Earning of Credits and Award of Grades.

The assessment / evaluation of the candidate is based on continuous assessment. The structure for evaluation is as follows:

For the purpose of assessment and evaluation, **a semester is divided into 3 discrete components identified as C1, C2, and C3.**

The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

(i) Component C1

The first component (C1), of assessment is for 25 marks. This will be based on test, assignment, seminar. During the first half of the semester, the first 50% of the syllabus (unit 1 and 2) will be completed. This shall be consolidated during the 9th week of the semester. Beyond 9th week, making changes in C1 is not permitted.

The finer split-up for the award of 25 marks in C1 is as follows:

Assignment/brief presentation/seminars	5 marks for unit 1
Assignment/brief presentation/seminars	5 marks for unit 2
A review test	15 marks for unit 1 and 2

(ii) Component C2:

The second component (C2), of assessment is for 25 marks. This will be based on test, assignment, seminar. The continuous assessment and scores of second half of the semester will be consolidated during the 18th week of the semester. During the second half of the semester the remaining units (unit 3 and 4)of the syllabus will be completed.

The finer split-up for the award of 25 marks in C2 is as follows:

Assignment/brief presentation/seminars	5 marks for unit 1
Assignment/brief presentation/seminars	5 marks for unit 2
A review test	15 marks for unit 1 and 2

In cases where these forms of assessment cannot be practiced, the respective school boards on the recommendation of the concerned faculty member may decide the form of assessment. However, the students are informed about the modalities well in advance.

The assessed / evaluated courses / assignments during Component - I (C1) and Component - II (C2) of assessment are immediately returned to the candidates after obtaining acknowledgement in the register maintained by the concerned teacher for this purpose.

(iii)Component C3:

The semester-end examination of 2 hours duration for each course will be conducted during the 19th and 20th week. This forms the third/final component of assessment (C3) and the maximum marks for the final component will be 50.

Valuation will be undertaken concurrently and results are announced latest by the end of 22nd week. This practice will be followed both in odd semester and even semester.

Provision for Appeal:

If a candidate is not satisfied with the assessment / evaluation of C1 and C2 components, he / she can approach the Grievance Cell with the written submission together with all facts, the assignments, test papers etc, which were assessed / evaluated. He / She can do so before the commencement of semester-end examination. The Grievance Cell is empowered to recommend to the Board of Management to revise the marks if the case is genuine. The Grievance Cell is also empowered to levy penalty as prescribed by the university on the candidate if his / her submission is found to be baseless and unduly motivated. This Cell may recommend taking disciplinary / corrective action on an evaluator if he / she is found guilty.

For every program there will be one Grievance Cell constituted by the Vice-Chancellor. The composition of the Grievance Cell is as follows:

(1) The Registrar (Evaluation) ex-officio Chairman / Convener
(2) One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/ discipline/ college and / or from a sister school / sister disciplines.
(3) One Senior Faculty Member / Subject Expert drawn from outside the University.

Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows.

Component – I	(C1):	Periodic Progress and Progress Reports (25%)
Component – II	(C2):	Results of Work and Draft Report (25%)
Component– III	(C3):	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

The schedule of continuous assessment and examinations are summarized in the following Table belows

Component	Period	Syllabus	Weightage	Activity
C1	1st Week to 8th Week	First 50% (two units)	25%	Instructional process and Continuous Assess-ment
	First 3 days of 9th Week			Consolidation of C1
C2	From fourth day of 9th Week to first 3 days of 17th Week	Second 50% (remaining two units)	25%	Instructional process and Continuous Assess-ment
	Last 3 days of 17th Week			Consolidation of C2
	18th Week			Revision and preparation for semester – end exam

C3	19st Week to 20th Week	Entire syllabus	50%	* Conduct of Semester -end Exams
	21st Week to 22nd Week			Evaluation and Tabulation
	22nd Week			Notification of Final Grades
***Examination and Evaluation shall take place concurrently and Final Grades be announced latest by 22nd week**				

A candidate's performance from all THREE components (i.e. C1, C2, C3) will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50).

Finally, awarding the Grades will be completed latest by the 24th week of the Semester.

Provision to Drop the Course / Repeat C3 Examination:

In case a candidate secures more than 30% in C1+C2 but less than 30% in C3, such a candidate may opt to DROP that course or may opt to appear for C3 examination during the subsequent examinations. In case he/ she opts to appear for just C3 examination, then the marks scored in C1+C2 shall get continued. Repeat C3 examinations will be conducted in every semester.

Re-Registration for Dropped Course:

A candidate has to re-register for the DROPPED course when the course is offered again by the concerned School / Department/ Centre if it is Hard Core Course. The candidate may choose the same or an alternative Soft Core or Open Elective in case the Dropped Course is Soft Core or Open Elective Course. A Candidate who is said to have DROPPED project or internship work has to re-register for the same subsequently within the stipulated period. **The details of any DROPPED course will not appear in the Grade Card.**

Provision to Withdraw Course

A candidate can WITHDRAW any course within in ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is Hard Core course, the same or an alternate course if it Soft Core or Open Elective course.

Provisional Grade Card:

The tentative / provisional grade card will be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. This statement will not contain the list of DROPPED courses.

Challenge Valuation

A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 10 days after the announcement of the results. This challenge valuation is only for C3 component. The answer scripts for which challenge valuation is sought for shall be sent to another examiner. The higher of two marks from first valuation and challenge value shall be the final.

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 Registrar (Evaluation).

Grade and the Grade Point:

The Grade and Grade Point earned by the candidate in the **subject studied** will be given as below:

Marks in Percentage [P]	Grade [G]	Grade Point (GP = V x G)
30-39	4	V*4
40-49	5	V*5
50-59	6	V*6
60-64	6.5	V*6.5
65-69	7	V*7
70-74	7.5	V*7.5
75-79	8	V*8
80-84	8.5	V*8.5
85-89	9	V*9
90-94	9.5	V*9.5
95-100	10	V*10

Here, P is the percentage of marks (P=[(C1+C2)+M] secured by a candidate in a course which is **rounded to nearest integer.** V is the credit value of course. G is the grade and GP is the grade point.

Cumulative Grade Point Average (CGPA):

Overall cumulative grade point average (CGPA) of a candidate after successful completion the required number of credits (176 for B Tech degree and 132 for Advanced Diploma in Engineering & Technology (ADET) is given by:

CGPA = ΣGP / Total number of Credits

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	FGP	
	Numerical Index	**Qualitative Index**
4 <= CGPA < 5	5	SECOND CLASS
5 <= CGPA < 6	6	
6 <= CGPA < 7	7	FIRST CLASS
7 <= CGPA < 8	8	
8 <= CGPA < 9	9	DISTINCTION
9 <= CGPA < =10	10	

Overall percentage=10*CGPA

GENERAL INSTRUCTIONS TO CANDIDATES ABOUT CBCS-CAGP

Students are advised to follow the instructions given below:

a. Every student is expected to attend the orientation program of CBCS organized by the University at central level/at school/department level and understand the system thoroughly before selecting the soft-core, open elective courses.

b. For all programs under CBCS, there will be a Faculty Adviser in every School/Department and a set of course teachers assigned to conduct the courses. Students shall consult any of them for clarifying their doubts and understand the scope of studying such choices, before selecting them. Particulars Soft Core courses are given in this handbook. However, particulars of Open Electives are provided in a separate handbook. Schedule of orientation modules conducted for fresher's will be intimated from the University at the time of commencement of the classes.

c. It is mandatory for every student, to register officially the courses opted under CBCS system in a Registration Form which contains details of core courses, hardcore, soft-core, open elective and foundation courses selected for a semester.

d. Registrations form the basis for a student to undergo sessional tests and end-semester examination. Application forms for examinations are to be filled based on the choices indicated in this form and submitted to the University along with the prescribed examination fee.

e. There will be a coordinating office for CBCS in the Campus of the University. Proper inter-departmental linkages will be done by this office. Circulars and notices will be issued by this office, whenever needed. In addition, they may also be scrolled in the University web-site.

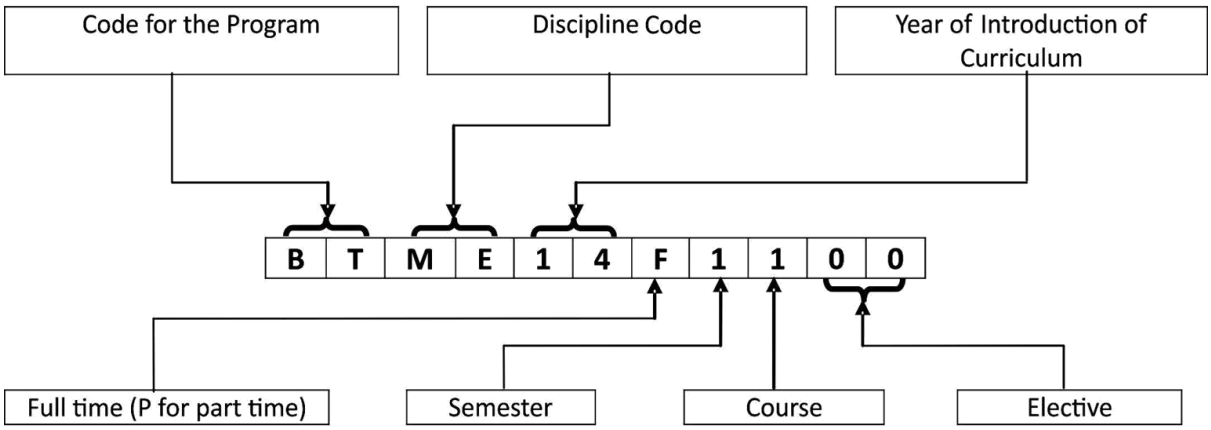
f. There will be no individual Correspondence made by the University, unless other-wise required for a specific reason.

g. Since Courses are conducted in more number of disciplines by various schools / departments, failure to comply with the requirements may lead to complications only to the defaulting students. Care should be taken by every student in attending the classes held in various buildings/halls as per the notified time-table.

h. Credits are assigned based on the structured distribution shown for every course of programs. Students opting for lateral exit, add on proficiency certification, add on proficiency diploma have to meet the coordinating officers and submit their application for lateral exit, add on proficiency certification, add on proficiency diploma with proper declarations.

Course Numbering Scheme for B. Tech Program

Course Numbers are denoted by character strings as shown below



B TECH IN MECHANICAL ENGINEERING (Full Time)

Eligibility for Admission:

The eligibility criteria for admission to B Tech Program of 4 years (8 Semesters) are given below:

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Technology (B Tech)	4 Years	Passed 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry Biotechnology / Biology / Technical Vocational subject Obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together
1	Bachelor of Technology (B Tech)	Lateral entry to second year	(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.
3	Bachelor of Technology (B Tech)	Lateral entry to fourth year (final year)	(F) Provided further that Students who completed successfully six Semesters in REVA University and have exited with Advanced Diploma in Engineering & Technology (ADET) shall be eligible for admission to the Fourth year B Tech degree courses subject to the vacancies. (G) Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective semester in the concerned branch of study.

Scheme of Instruction

Sl No	Course Code	Title of the course	HC/ SC/ OE	Credit Pattern & Credit Value				Contact Hrs.	Teaching School/ Dept
				L	T	P	Total		
FIRST SEMESTER									
1	BTME14F1100	Engineering Mathematics-I	HC	3	1	0	4	5	Maths
2	BTME14F1200	Engineering Physics	HC	3	0	1	4	5	Physics
3	BTME14F1300	Environmental Studies	FC	2	0	0	2	2	Chemistry
4	BTME14F1400	English for Professional Communication & Technical Writing	FC	3	0	1	4	5	English
5	BTME14F1500	Basic Electrical & Electronics Engineering	HC	3	1	0	4	5	Electrical
6	BTME14F1600	Basic Mechanical Engineering & workshop	HC	3	0	1	4	5	ME
		Total Credits		**17**	**2**	**3**	**22**	**27**	
SECOND SEMESTER									
1	BTME14F2100	Engineering Mathematics-II	HC	3	1	0	4	5	Maths
2	BTME14F2200	Engineering Chemistry	HC	3	0	1	4	5	Chemistry
3	BTME14F2300	Constitution of India & Professional Ethics	FC	2	0	0	2	2	Mgmt. Studies
4	BTME14F2400	Computer Programming skills & applications	HC	3	0	1	4	5	CSE
5	BTME14F2500	Computer Aided Engineering Drawing	HC	2	0	2	4	6	ME
6	BTME14F2600	Engineering Mechanics	HC	3	1	0	4	5	CV
		Total Credits		**16**	**2**	**4**	**22**	**28**	

SLNo	Course code	Title of the Course	Types of course HC/ SC	Credit Pattern & Credit Value				Contact Hrs.	Teaching School/ Dept
				L	T	P	Total		
THIRD SEMESTER									
1	BTME14F3100	Engineering Mathematics-III	HC	3	1	0	4	5	Maths
2	BTME14F3200	Material science	HC	3	0	0	3	3	ME
3	BTME14F3300	Strength of Materials	HC	3	1	0	4	5	ME
4	BTME14F3400	Basic Thermodynamics	HC	3	1	0	4	5	ME
5	BTME14F3500	Computer Aided Machine Drawing	HC	1	0	2	3	7	ME
6	BTME14F3600	Manufacturing Technology-I	HC	3	0	0	3	4	ME
7	BTME14F3700	Material Science Lab	HC	1	0	1	2	4	ME
8	BTME14F3800	Foundry and Forging Lab	HC	1	0	1	2	4	ME
		Total Credits		**19**	**2**	**4**	**18**	**37**	
FOURTH SEMESTER									
1	BTME14F4100	Theory of Machines-I	HC	3	1	0	4	5	ME
2	BTME14F4200	Engineering Fluid Mechanics	HC	3	1	0	4	5	ME
3	BTME14F4300	Manufacturing Technology-II	HC	3	0	0	3	4	ME
4	BTME14F4400	Mechanical Measurements & Instrumentation	HC	2	1	0	3	4	ME
5	BTME14F4500	Applied Thermodynamics	HC	3	1	0	4	5	ME
6	BTME14F4600	Principles of Management	HC	1	1	0	2	3	ME
7	BTME14F4700	Machine Shop	HC	1	0	1	2	4	ME
8	BTME14F4800	Measurement and Instrumentation Lab	HC	1	0	1	2	4	ME
		Total Credits		**17**	**5**	**2**	**24**	**34**	

FIFTH SEMESTER									
SL No	**Course code**	**Title of the Course**	**Types of course HC/ SC/OE**	**Credit Pattern & Credit Value**				**Contact Hrs**	**Teaching School / Dept**
				L	**T**	**P**	**Total**		
1	BTME15F5100	Turbo Machinery	HC	3	1	0	4	5	ME
2	BTME15F5200	Machine Design-I	HC	3	1	0	4	5	ME
3	BTME15F5300	Hydraulics & Pneumatics	HC	3	0	0	3	3	ME
4	BTME15F5400	Theory of Machines-II	HC	3	1	0	4	5	ME
5	BTME15F5500	Numerical Methods for Mech. Engg	HC	3	0	0	3	3	ME
6	BTME15F5610	**Internal Combustion Engine**	SC	3	0	0	3	3	ME
	BTME15F5620	Processing of materials in manufacturing	SC	3	0	0	3	3	ME
	BTME15F5630	Statistical Quality Control	SC	3	0	0	3	3	ME
	BTME15F5640	Power Plant Engineering	SC	3	0	0	3	3	ME
7	BTME15F5700	Fluid Machinery Lab	HC	0	0	2	2	4	ME
8	BTME15F5800	Energy Conversion Lab	HC	0	0	2	2	4	ME
		Total Credits		**18**	**3**	**4**	**25**	**28**	
SIXTH SEMESTER									
1	BTME15F6100	CAD/CAM/CIM	HC	3	0	0	3	3	ME
2	BTME15F6200	Machine Design-II	HC	3	1	0	4	5	ME
3	BTME15F6300	Finite Element Method	HC	3	1	0	4	5	ME
4	BTME15F6400	Heat & Mass Transfer	HC	3	1	0	4	5	ME
5	BTME15F6510	Refrigeration and Air-conditioning	SC	3	0	0	3	3	ME
	BTME15F6520	Manufacturing Technology-III	SC	3	0	0	3	3	ME
	BTME15F6530	Production Planning & Control	SC	3	0	0	3	3	ME
	BTME15F6540	Theory of Elasticity	SC	3	0	0	3	3	ME
6	BTME15F6610	Renewable Energy Resources	SC	3	0	0	3	3	ME
	BTME15F6620	Mechatronics & Microprocessor	SC	3	0	0	3	3	ME
	BTME15F6630	Industrial Engineering	SC	3	0	0	3	3	ME
	BTME15F6640	Experimental Stress Analysis	SC	3	0	0	3	3	ME
7	BTME15F6700	Heat & Mass Transfer Lab	HC	0	0	2	2	4	ME
8	BTME15F6800	CAMA Lab	HC	0	0	2	2	4	ME
		Total Credits		**18**	**3**	**4**	**25**	**28**	

FIFTH SEMESTER									
SL No	**Course code**	**Title of the Course**	**Types of course HC/ SC/OE**	**Credit Pattern & Credit Value**				**Contact Hrs**	**Teaching School / Dept**
				L	**T**	**P**	**Total**		
1	BTME15F7100	Control systems	HC	3	0	0	3	3	ME
2	BTME15F7200	Mechanical Vibrations	HC	3	1	0	4	5	ME
3	BTME15F7300	Operation Research	HC	3	1	0	4	5	ME
4	BTME15F7410	Cryogenic Engineering	SC	3	0	0	3	3	ME
	BTME15F7420	Product Design and Development	SC	3	0	0	3	3	ME
	BTME15F7430	Engineering economics & Financial Management	SC	3	0	0	3	3	ME
	BTME15F7440	Theory of plasticity	SC	3	0	0	3	3	ME
5	BTME15F7510	Computational Fluid Dynamics	SC	3	0	0	3	3	ME
	BTME15F7520	Nano Technology and Applications	SC	3	0	0	3	3	ME
	BTME15F7530	Tribology & Bearing Design	SC	3	0	0	3	3	ME
	BTME15F7540	Automation in Manufacturing	SC	3	0	0	3	3	ME
6		Open Elective	SC	3	0	0	3	3	Other
7	BTME15F7700	CIM & Automation Lab	HC	0	0	2	2	2	ME
8	BTME15F7800	Design Lab	HC	0	0	2	2	2	ME
Total Credits				**18**	**2**	**4**	**24**	**26**	
1	BTME15F8100	Professional Ethics & Safety Measures in Mechanical Engineering	HC	3	0	0	3	3	ME
2	BTME15F8210	Automotive Engineering	SC	3	0	0	3	3	ME
	BTME15F8220	Robotics	SC	3	0	0	3	3	ME
	BTME15F8230	Operation Management	SC	3	0	0	3	3	ME
	BTME15F8240	Mechanics of Composite Materials	SC	3	0	0	3	3	ME
3	BTME15F8310	Biomass Energy	SC	3	0	0	3	3	ME
	BTME15F8320	Rapid Prototyping	SC	3	0	0	3	3	ME
	BTME15F8330	Non Destructive Testing Methods	SC	3	0	0	3	3	ME
	BTME15F8340	Machine Tool Design	SC	3	0	0	3	3	ME
4	BTME15F8400	Major Project	HC	0	0	6	6	12	ME
Total Credits				**12**	**0**	**8**	**17**	**25**	

DETAILED SYLLABUS

FIRST SEMESTER

Course Title	**ENGINEERING MATHEMATICS - I**		
Course Code	BTME14F1100	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

Course Objectives:
To study and understand the application approach of the concepts of linear algebra, differential calculus, partial differentiation, solid geometry, and Numerical Methods.

Course Outcome:

1. The student becomes conversant with the fundamentals of Linear algebra.

2. The problems in OR, Computer science, Probability, statistics deals with functions of two or more variables. To optimize something means to maximize or minimize some aspects of it.
3. Students will learn the basic polynomial interpolation methods and their use with numerical integration methods.
4. Students will learn the basic numerical methods for solving initial value problems and their characteristic properties.
5. Students will learn the concepts of order, stability, and convergence of a numerical method.

6. Students will learn the basic numerical methods for solving boundary value problems and their characteristic properties.

Course Code	**POS/ COs**	**P O1**	**P O2**	**P O3**	**P O4**	**P O5**	**P O6**	**P7**	**P O8**	**P O9**	**P O 10**	**P O 11**	**P O 12**	**PS O1**	**PS O2**	**PS O3**
BTME14F1100	**CO1**	**3**	**2**	**1**										**3**	**3**	**3**
	CO2	**2**	**3**	**2**		**2**								**3**	**3**	**2**
	CO3	**3**	**2**	**1**										**3**	**2**	**3**
	CO4	**3**	**2**	**1**										**3**	**2**	**3**
	CO5	**2**	**3**	**1**										**3**	**2**	**2**
	CO6	**3**	**3**	**1**										**3**	**2**	**2**

Course Contents:

Unit-1: Matrix Theory: [17hrs]

Matrix Theory: Elementary row and column operations on a matrix, Rank of matrix – Normal form – Inverse of a matrix using elementary operations –Consistency and solutions of systems of linear equations using elementary operations, Gauss Seidal iteration method - linear dependence and independence of vectors - Characteristic roots and vectors of a matrix - Caley-Hamillton theorem and its applications, Calculation of dominant eigen value by iteration - Reduction to diagonal form – Reduction of a quadratic form to canonical form – orthogonal transformation and congruent transformation.

Unit-2: Differential Calculus: [18hrs]

Successive differentiation, standard results, Leibnitz Theorem(without proof) and problems, Rolles Theorem, Lagranges Mean Value Theorem, Maclaurins series, Taylors series expansion, Intermediate forms and solution using L'Hospital's rule Tangents and Normal-cartesian curves, polar curves, Angle between polar curves, Pedal equation for polar curves. Derivative of arc length – concept and formulae without proof. Radius of curvature-Cartesian, parametric, polar and pedal forms.Maxima and Minima of a function and its applications.

Unit-3: Partial Differentiation and Solid Geometry [17 hrs]

Partial Differentiation: Partial derivatives, total derivative and chain rule, Jacobians - direct evaluation. Taylor's Expansion f a function of two variables. Maxima and Minima for function of two variables. Solid Geometry:

Unit-4: Numerical Methods: [18hrs]

Solution of a system of linear equations by L-U decomposition, Gauss-Jordan and Gauss-Seidel Methods, Newton's interpolation formulae, Lagranges interpolation, Solution of a polynomial and a transcendental equation by Newton-Raphson method, numerical integration by trapezoidal rule, Simpson's rule and Gaussian quadrature, numerical solutions of first order differential equation by Euler's method and 4th order Runge-Kutta method.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers

2. Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.

Reference Books:

1. B.V. Ramana, Higher Engineering Mathematics, Latest edition, Tata Mc. Graw Hill Publications.
2. R.K.Jain and S.R.K.Iyengar : Advanced Engineering Mathematics, Narosa Publishing House, Latest Edition.

Course Title	**ENGINEERING PHYSICS**		
Course Code	BTME14F1200	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

Course Objectives:

1. To make a bridge between the physics fundamentals which they studied in schools and their applications which they are going to study in engineering courses.
2. To be acquainted with the basic concepts of elastic properties of matter, Ultrasonic, lasers, and optical fibers
3. To get exposed to advanced engineering materials

Course Outcome:

On completion of this course the student will be able to:

1. Understand the advanced concepts in nondestructive testing methods.

2. Understand and demonstrate different applications of lasers and optical fibers in engineering ,industrial fields
3. select specific materials for their requirements

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
BTME14F1200	**CO1**	**3**	**3**	**1**										**3**	**3**	**2**
	CO2	**3**	**2**	**2**										**3**	**3**	**3**
	CO3	**3**	**3**	**2**										**3**	**2**	**2**

Course Contents:

Unit-1: Elasticity, Kepler's laws and Ultrasonics [12hrs]

Elasticity: Introduction- stress and strain- Hooke's law- stress strain diagram- factors effecting elasticity-, Types

Bending of beams, expression for the bending moment and depression of cantilever loaded at its end- non uniform bending-expression for depression at the midpoint of the beam loaded at the middle- uniform bending- expression for elevation at the center of the beam loaded at both the ends- experimental determination of y by cantilever and uniform bending methods- I shaped griders.

Kepler's laws: Kepler's laws of planetary motion- proof of Kepler's laws – satellites- time period of satellite-state of weightlessness
Ultrasonics: production of ultrasonic by piezoelectric method, measurement of velocity of ultrasonic in liquids and solids, determination of elastic moduli in terms of ultrasonic velocities and nondestructive testing using ultrasonic

Unit-2: Lasers, optical fibers and optical instruments [12hrs]

Lasers : Introduction to Laser-characteristics of Laser light -basic principles (spontaneous and stimulated emissions),Einstein' s quantum theory of radiation, Expression for energy density at thermal equilibrium in terms of Einstein's coefficients Conditions for light amplification, population inversion , pumping, active medium Optical resonator cavity, Threshold population inversion, conditions for laser action, construction, working. Merits, demerits of Ruby laser, He - ne laser, and Semiconductor laser, Applications: Industrial applications. (Laser welding, cutting, drilling methods) Holography: recording and reconstruction of images and its applications.

Optical fiber Introduction, construction and propagation mechanism in optical fibers (total internal reflection and its importance), Acceptance angle, condition for propagation, numerical aperture , V-number and Modes of propagation, Types of optical fibers, Attenuation and reasons for attenuation, Applications: Explanation of optical fiber communication using block diagram , advantages and limitations of optical communication systems, Endoscopes and their applications in engineering, medical, industrial fields and optical fiber sensors Optical instruments-Sextant-Applications of sextant-measurement of height of building, altitude of the sun- Basics of microscope-metallurgical microscope(optical)- electron microscope-Scanning electron microscope(SEM)-sample preparation techniques-differences between an optical and an electron microscope

Unit-3: Material properties of conductors, super conductors, Smart materials [12hrs]

Electrical Conductivity in Metals- Concept of free electron. Classical Free Electron Theory -Assumptions. Drift velocity, Mean free path and mean collision time. Relaxation time, Expression for electrical conductivity in metals, Effect of impurity and temperature on electrical resistivity in metals, Failures of CFET. Formation of Energy bands in solids ,QFET assumptions Fermi Dirac statistics. Mean energy and Fermi energy of electrons at 00K and Fermi factor, Density of states (explanation), effective mass, Expression for electrical conductivity. Merits of QFET.

Super conductors: Introduction, definitions of super conductivity, critical temperature, critical field, Properties of super conductors, Isotope effect, Meissner effect, Silsbee effect, types of superconductors, BCS theory, Quantum interference, Josephson's effect, Applications : Maglev vehicle, squid, superconducting magnets Smart materials : Shape memory alloys- pseudo elasticity-applications

Unit-4: Properties of Dielectric, Magnetic, and Nano materials [12hrs]

Dielectric materials Electric dipole and dipole moment, electric polarization(P) dielectric susceptibility (χ,)and dielectric constant and, relation between χ, and P. Static dielectric constant determination and temperature dependence, frequency dependence, Electrical polarization mechanisms, electronic ,ionic, orientational , space charge polarization, Expression for internal field in one dimensional solid dielectrics, Ferro and Piezo

Magnetic materials: classification of magnetic materials and their properties, Langevin's theory for dia, para, magnetic materials and Weiss theory for Ferro magnetic materials (qualitative). B-H curve of Ferro magnetic materials. Hard and soft magnetic materials properties and Applications.

Nano materials - Introduction and types and properties - synthesis (chemical vapour deposition and ball milling methods) - applications. Carbon Nano Tubes: structure and properties - synthesis- (arc method) applications.

Text Books:

1. Engineering physics, R.K Gaur and S.L. Gupta, Dhanpat Rai Publications(P) Ltd, New Delhi
2. A text book of Engineering physics, M.N. Avadhanulu and P.G. Kshirsagar, S.Chand and Company, New Delhi.
3. Solid state Physics, S.O.Pillai, New Age International publishers, New Delhi

Reference Books:

1. Laser Fundamentals, William T. Silfvast, 2nd edn, Cambridge University press, New York (2004)
2. Fundamentals of Physics, 6th Edition, D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, New York (2001).
3. Introduction to solid state physics,7th Edn, Charls Kittel, Wiley, Delhi (2007)
4. Arthur Beiser, Concepts of modern Physics, TataMcGraw Hill publications, New delhi.

PHYSICS LAB

Lab Exercises:

1. Determination of wavelength of the given laser using diffraction grating
2. Determination of young's modulus of the material by single cantilever method/uniform bending method
3. Determination of rigidity modulus of the material of the suspension wire and moment of ineria of a irregular body using torsional pendulum.
4. Measurement of dielectric constant by charging and discharging methods
5. Measurement of numerical aperture and attenuation in optical fibers
6. Determination of Fermi energy of copper
7. Study of retentivety and coercivety by B-H graph method
8. Measurement of velocity of ultrasonics in the given liquid-acoustic grating method
9. Measurement of acceleration due to gravity by bar pendulum.
10. Determination of electrical resistivity by four probe method

Reference Book:

1. Laboratory manual in applied Physics, Hannah Sathyaseelan, New Age international publishers

Course Title	ENVIRONMENTAL STUDIES		
Course Code	BTME14F1300	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	2-0-0=2	Exams Hrs	3
Total No. of Contact Hrs per Week	2-0-0=2	Exam Marks	50

Course Objectives:

1. The course is to understand the fundamental concepts of Environment and its Components like air, water, soil and minerals.
2. To understand the working of various bio diversities, Ecosystems, and natural resources.
3. To acquire the knowledge of transformation of Energy in the nature in different forms.
4. To get familiarized with the problems of the earth like pollution, degradation, overpopulation etc.

Course Outcome:

1. Analyze the environmental conditions and protect it. Identify and recognize the role of
2. Individual, government and NGO in environmental protection.
3. List and illustrate the causes of environmental pollution & find ways to overcome them.
4. Express motivation to find new renewable energy resources with high efficiency through active research & design pollution controlled products

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME14F1300	**CO1**	**3**	**3**	**2**										**3**	**3**	**3**
	CO2	**3**	**3**	**2**										**3**	**2**	**3**
	CO3	**3**	**3**	**2**										**3**	**2**	**2**
	CO4	**2**	**3**	**2**										**3**	**3**	**3**

Course Content:

Unit-1: Introduction **7 hours**

Basic definitions, Objectives and Guiding principles of Environmental Studies, Components of Environment, Structures of atmosphere, Man-Environment relationship, Impact of Technology on the environment , sustainable environment, Ecosystems Environmental Protection - Role of Government, Legal aspects, Initiatives by Non - Governmental Organizations (NGO), Environmental Education, Women Education.

Unit-2: Energy & Natural Resources **6 hours**

Energy - Different types of energy, Electro-magnetic radiation. Conventional and Non-Conventional sources - Hydro Electric, Fossil fuel based, Nuclear, Solar, Biomass and Bio-gas. Hydrogen as an alternative future source of Energy, Natural Resources- Water resources, Mineral Resources, Forest Wealth, Material Cycles - Carbon, Nitrogen and Sulphur Cycles

Unit-3: Ecology & Ecosystems **6 hours**

Ecology- Objectives and Classification, Concept of an ecosystem - structure & function, Balanced ecosystem, Components of ecosystem - Producers, Consumers, Decomposers, Bio-Geo- Chemical Cycles & its Environmental significance, Energy Flow in Ecosystem, Food Chains: Types & Food webs Ecological Pyramids.

Unit-4: Environmental Pollution **7 hours**

Environmental Degradation, Pollution, Sources of Pollution, Types of Environmental Pollution , Air Pollution: Definition, Sources of Air pollution, Pollutants, Classifications of Air pollutants , (common like SOX & NOX),

Sources & Effects of common air pollutants, ambient Air Quality Standards, Water Pollution: Definition, Sources Water pollution, Pollutants & Classification of water pollutants, Water Quality Standards, Effects of Water Pollution, Eutrophication, Noise Pollution: Sources of Noise Pollution, Effects of noise pollution ,Soil Pollution Current Environmental Global issues, Global Warming & Green Houses, Effects, Acid Rain, Depletion of Ozone Layer.

Text Books:

1) Benny Joseph (2005), "Environmental Studies", Tata McGraw – Hill Publishing Company Limited

2) Ranjit Daniels R.J. and Jagdish Kirshnaswamy, (2009), "Environmental Studies", Wiley India Private Ltd., New Delhi
3) Rajagopalan R. (2005), "Environmental Studies – From Crisis to Cure", Oxford Univesity Press

Reference Books:

1) Raman Sivakumar, (2005), "Principles of Environmental Science and Engineering", Second Edition, Cengage learning, Singapore
2) Meenakshi P. (2006), "Elements of Environmental Science and Engineering", Prentice Hall of India Private

3) Prakash S.M. (2007), "Environmental Studies", Elite Publishers, Mangalore

4) Erach Bharucha (2005), "Text Book of Environmental Studies", for UGC, University Press

5) Tyler Miller Jr. G. (2006), "Environmental Science – Working with the Earth", Eleventh Edition, Thomson Brooks/Cole
6) "Text Book of Environmental and Ecology" by Dr. Pratibha Sing, Dr. Anoop Singh and Dr. Piyush Malaviya. Acme Learning Pvt. Ltd., New Delhi.

Course Title	**English for Professional Communication & Technical Writing**		
Course Code	BTME14F1400	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-0-1=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

PREREQUISITE: Basic English Communication.

Course Objectives:

1. Communicative English Syllabus addresses the needs of Engineering under graduate students to enable them to use the English language effectively as day to day technical/business communication tool.
2. To understand and use spoken English to develop proficiency in theory and communicative skills.

3. To communicate orally in English and its usage in formal, semi-formal and official situations.

4. To read, write and comprehend texts.

5. To understand and use effective writing skills to express ideas and present information.

6. To expand the use of English grammar in a stimulating and professional manner.

7. To familiarize about adapting their listening, reading and writing for various audiences and contexts they might encounter professionally.

Course Outcome:

On completion of this course, students will be able to:

1. Accurately and precisely communicate – both in speaking and writing.

2. Demonstrate a decent command of English and its linguistic structures.

3. Analyze the structure and evolution of English words and texts from the point of view of Phonology, Grammar, Syntax and Semantics.
4. Tailor communication to, and engage in persuasive communication with, specific audience and media.
5. Analyze rhetorical aspects of audience, purpose, and context to communicate technical information effectively in written, oral, and visual Forms.
6. Produce and deliver written and oral presentations, using appropriate media and technology.

7. Understand the structure and distinctions of Technical Paper, Project Dissertation and Thesis - typically used in Science and Engineering.
8. Approach the literature relevant to your field of study with a critical eye.

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME14F1400	**CO1**	**2**	**2**											**2**	**2**	**1**
	CO2	**2**	**2**											**2**	**1**	**1**
	CO3	**2**	**2**											**2**	**2**	**1**
	CO4	**2**	**2**											**2**	**1**	**1**
	CO5	**2**	**2**											**2**	**2**	**1**
	CO6	**2**	**2**											**2**	**1**	**1**
	CO7	**2**	**2**											**2**	**1**	**1**
	CO8	**2**	**2**											**2**	**1**	**1**

Course Content:

Unit–1: Basics of Technical Communication 12Hrs

Introduction, Process of Communication, Language as a Tool, levels of Communication, Communication networks, flow of Communication, importance of technical Communication; Barriers to Communication; **Reading skill:** Intensive and extensive reading, skimming and scanning. Grammar: Prepositions, reference words, Wh-questions, Tenses (Simple, present); Vocabulary: word formation, word expansion (root words/ etymology).

Unit–2: Active Listening and Technology in Communication 12Hrs

Active Listening: Difference between listening and hearing, Types of listening, traits of a good listener.

Technology in communication: Software for creating messages, software for writing documents, software

for presenting documents. Grammar: use of imperatives, tenses (Past), use of sequence words, Adjectives;

Vocabulary: Different forms and uses of words, Cause and effect words.

Unit–3: Effective Presentation Strategies 12Hrs

Introduction, Defining purpose, analyzing audience and locale, organizing contents, preparing outline, Visual Aids, understanding nuances of delivery, Kinesics, Proxemics, Paralinguistic's, Chronemics, sample speech, Group Discussion and seminar presentation. Grammar: Adverbs, Tenses (future time reference); Vocabulary: Single word substitutes, use of abbreviations and acronyms.

Unit–4: Constituents of Technical Written Communication 12Hrs

Writing Skill: Basic rules, Introductory grammar, common errors; Business letters: sales and credit letters,

letter of enquiry, order claim and adjustment letters; Reports: Types, significance, structure, style of writing reports; Technical proposals: Parts, types, significance, writing of proposal; writing CVs, cover letters, official correspondence, letter for approval of the authority, circular, agenda, notice, press release, report writing about the proceedings of any seminar. Technical paper, Project Dissertation and Thesis (only Structure). Grammar: Accuracy and fluency focused activities – Fillers, turntaking, pauses, phatic; Vocabulary: Lexical item (fixed/ semi fixed expressions).

Text Books:

1. Technical Communication – Principles and Practices by Meenakshi Raman and Sangeeta Sharma: Oxford University Press, 2007.
2. Improve Your Writing ed. V. N. Arora and Laxmi Chandra, Oxford University Press, 2001, New Delhi.
3. Technical Communication – A Practical Approach by Madhu Rani and Seema Verma, Acme Learning 2011, New Delhi.

Reference Books:

1. English language Laboratories: A Comprehensive Manual by Nira Konar, PHI
2. Words at Work by David Honer, Peter Strutt, CUP
3. Business Correspondence and Report Writing by R. C. Sharma, Krishna Mohan, Tata McGraw Hill.
4. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt.Ltd, 2011, New Delhi.
5. Business Correspondence and Report Writing by Prof. R.C.Sharma & Krishna Mohan, Tata McGraw Hill & Co.Ltd.,2001, New Delhi.
6. Developing Communication Skills by Krishna Mohan, Mecra Bannerji- Macmillan India Ltd. 1990, Delhi.
7. Manual of Practical Communication by L.U.B.Pandey: A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.
8. Spoken English- A manual of Speech and Phonetics by R.K.Bansal & J.B.Harrison, Orient Blackswan, 2013, New Delhi.
9. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.
10. Business English by Ken Taylor, Orient Blackswan, 2011, New Delhi.

Suggested Extensive Reading:

1. Wise and Otherwise by Sudha Murthy, Penguin Books India, 2006.

2. Business @ the Speed of Thought – Succeeding in the Digital Economy by Bill Gates and Collins Hemingway, Warner Business Books, New York, 2000.

Website Resources:

1. BBC learning English; www.bbc.co.uk/worldservice/learningenglish
2. English Listening Lounge; www.englishlistening.com
3. Learning through listening; www.learningthroughlistening.org
4. www.uefap.com
5. www.eslcafe.com
6. www.listen-to-english.com
7. www.owl.english.purdue.edu
8. www.chompchomp.com

Exercise/Activities at the end of Unit- 1

Listening	Listen to an introductory model speech (audio and video)
Speaking	Speak about one's Place, important Festivals, Introducing oneself, one's family/ Friend.
Reading	Skimming a reading Passage, Scanning for specific information, read atleast one Autobiographical writing. Note-making.
Writing	Free writing on any given topic (My favorite Place/ Hobbies/ School life, etc.).

Exercise/Activities at the end of Unit- 2

Listening	Listening and responding to video lectures/talks.
Speaking	Describing a simple process (filling of form, etc.); Asking and Answering questions.
Reading	Critical reading – finding key information in a given text (sifting facts from Opinions).
Writing	Biographical writing (Place, People etc.); lab descriptions (general/specific description of laboratory experiments).

Exercise/Activities at the end of Unit- 3

Listening	Listening to specific task-focused audio tracks
Speaking	Role-Play – Simulation, group interaction, speaking in formal situations(Teachers, Officials, Foreigners)

Reading	Reading and interpreting visual Ad materials
Writing	Jumbled Sentences-coherence and Cohesion in writing, Channel conversion (flowchart, line graphs, pie chart etc. into text format)

Exercise/Activities at the end of Unit- 4

Listening	Watching Videos/Documentaries and responding to questions based on them
Speaking	Responding to questions – attending different forms of mock interviews (Technical, GD & HR)
Reading	Making inference from the reading passage, predicting the content of a reading passage
Writing	Atleast 2 official letters, CV writing and Essay writing

Text Books:

1. Technical Communication – Principles and Practices by Meenakshi Raman and Sangeeta Sharma: Oxford University Press, 2007.
2. Improve Your Writing ed. V. N. Arora and Laxmi Chandra, Oxford University Press, 2001, New Delhi.
3. Technical Communication – A Practical Approach by Madhu Rani and Seema Verma, Acme Learning 2011, New Delhi.
4. Lannon, J. and Laura Gurak. Technical Communication. Boston: Longman, 12th edition, 2011.

Reference Books:

1. English language Laboratories: A Comprehensive Manual by Nira Konar, PHI
2. Words at Work by David Honer, Peter Strutt, CUP
3. Business Correspondence and Report Writing by R. C. Sharma, Krishna Mohan, Tata McGraw Hill.
4. Communication Skills for Engineers and Scientists, Sangeeta Sharma, & Binod Mishra et.al. PHI Learning Pvt.Ltd, 2011, New Delhi.
5. Communicative English for engineers and Professional by Nitin Bhatnagar, Mamta Bhatnagar, Pearson India.
6. Business Correspondence and Report Writing by Prof. R.C.Sharma & Krishna Mohan, Tata McGraw Hill & Co.Ltd.,2001, New Delhi.
7. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. &Distributors, 2009, New Delhi.
8. Developing Communication Skills by Krishna Mohan, Meera Bannerjee- Macmillan India Ltd. 1990, Delhi.
9. Manual of Practical Communication by L.U.B.Pandey: A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, New Delhi.
10. Spoken English- A manual of Speech and Phonetics by R.K.Bansal & J.B.Harrison, Orient Blackswan, 2013, New Delhi.
11. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.
12. Business English by Ken Taylor, Orient Blackswan, 2011, New Delhi.
13. Longman Student Grammar of Spoken and Written English

14. Mindscapes: English for Technologists and Engineers. Orient Blackswan

15. English and Communication Skills for Students of Science and Engineering Dhanavel, S.P. Orient Blackswan
16. Technical Communication: A Reader-Centered Approach by Anderson, Paul V.

17. Communication Skills for Engineers by Muralikrishna, & Sunita Mishra. Pearson

18. English for Engineers. Regional Institute of English. Cambridge University Press

19. Technical Communication by Riordan, Daniel. G. Cengage Learning

20. Effective Technical Communication by Rizvi, Ashraf. M.. Tata McGraw-Hill

21. Basic Communication Skills for Technology by Rutherford, Andrea. J. Pearson

22. Technical Writing for Success by Smith-Worthington, Darlene & Sue Jefferson.

23. English for Technical Communication by Viswamohan, Aysha. Tata McGraw-Hill.

24. English Language Laboratories: A Comprehensive Manual – Nira Konar, PHI

25. Business Matters – Mark Powell, Thomson Heinle

26. Words at Work –David Horner, Peter Strutt, CUP

27. Commercial Correspondence –A. Ashley, OUP

28. Business Correspondence and Report Writing – R.C. Sharma, Krishna Mohan, Tata McGraw Hill

29. Communicating in Business, Simon Sweeney, CUP

30. Cambridge Advanced English: Students Book by Jones, Leo -Cambridge University Press 1998

31. Listening and Responding: Sandra D.Collins- Cengage Learning India.

32. Company to Company – Andrew Littlejohn, CUP.

33. Communicative English – Meenakshi Raman and Sangeeta Sharma, OUP

34. Business Communication – Meenakshi Raman and Prakash Singh,

35. Wise and Otherwise by Sudha Murthy, Penguin Books India, 2006.

36. Business @ the Speed of Thought – Succeeding in the Digital Economy by Bill Gates and Collins Hemingway, Warner Business Books, New York, 2000.

Course Title	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**		
Course Code	BTME14F1500	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

Course Objectives:

1. To enable students to establish a broad concept of various types of generation of electricity.
2. To enable students to understand the basics of representation of electrical quantities and relationship among them.
3. To provide an overview of various types of electrical apparatus.
4. To introduce the concept of domestic wiring and importance of safety and sensing devices.
5. To enable students to understand the concepts of basic electronic devices.

Course Outcome:

1. Be able to describe the operation and control of various types of generation of electricity
2. Be able to describe the principle of operation of electrical apparatus and of electronic devices
3. Be able to differentiate between single and three phase systems
4. Be able to solve simple mathematical relationships related to electrical apparatus.
5. Be able to relate the applications of electronic devices and sensors in practical life.

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BTME14F1500	**CO1**	**3**	**2**	**2**										**3**	**2**	**3**
	CO2	**3**	**2**	**2**										**3**	**3**	**2**
	CO3	**3**	**2**	**3**										**3**	**3**	**3**
	CO4	**3**	**2**	**2**										**3**	**3**	**3**
	CO5	**3**	**2**	**3**										**3**	**2**	**2**

Course Content:

Unit-1: Introduction: [17hrs]

Concept of Alternating Voltage and Current, Sinusoidal functions-specifications, Phasor representation, concept of impedance, admittance, conductance and suscptance, Concept of power and power factor. Generation of three phase voltages, star-Wye configurations, relation between line and phase quantities and expression for power. Block diagram representation of thermal, hydel, nuclear, diesel and renewable power plants. Electrical power transmission scheme, need for transmission at high voltage, power factor correction. Concept of smart-grid and role of ICT in smart-grid.

Unit-2: Electrical apparatus: [18hrs]

DC generator, DC motor, Single and three phase induction motors, shaded pole motor, universal motor, and stepper motor: Basic construction, principle of operation and applications. Single and three-phase transformers: Principle, emf equation.

Unit-3: Tariff, Protective devices and sensors: [17hrs]

Tariff schemes, basic concepts of domestic wiring and types, earthing, protective fuses, MCB. Sensors: pressure sensor, strain gage, proximity sensor, displacement sensor, rotary encoder and ultrasonic sensors (applications in relevant disciplines- ref to 8 and 9)

Unit-4: Electronic devices: [18hrs]

Diode bridge circuit theory and design, transistor configurations and applications (thermistor controlled switch, LDR and relay circuit, Light operated transistor switch). SCR, controlled rectifier-fullbridge type. Oscillators and applications. OPAMP-summer, subtractor, integrator and differentiator, and typical applications in measurements.

Reference Books:

1. Mittle V.N. and A. Mittal, "Basic Electrical Engineering" Tata McGraw Hill, 2nd Edition
2. Kulshreshtha C, "Basic Electrical Engineering" Tata McGraw Hill, 2nd Edition
3. Kothari D.P., L.J. Nagrath "Basic Electrical Engineering", Tata McGraw Hill
4. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education, 5th Edition
5. A.K. Sawhney, "A course in Electrical and Electronic Measurements and Instrumentation" 18th Edition, Dhanpat Rai and Co.
6. Introduction to smart grid: http://www.occ.ohio.gov/publications/electric/Smart_Grid_An Introduction.pdf
7. Role of ICT in smart grid:http://users.atlantis.ugent.be/cdvelder/papers/2010/develder2010sgc.pdf
8. Sensors:http://www.omron-ap.co.in/technical_guide/
9. Strain gage with bridge circuit: http://www.facstaff.bucknell.edu/mastascu/elessonshtml/Sensors/StrainGage.htm#SensorsInVoltageDividerCircuits
10. Robert L. Boylestad and Louis Nashelsky, "Introduction to Electricicty, Electronics and Electromagnetics" Prentice Hall

Course Title	**ELEMENTS OF MECHANICAL ENGINEERING AND WORKSHOP**		
Course Code	BTME14F1600	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

Course Objectives:

1. To develop the basic knowledge of working of various turbines and IC engines
2. To incorporate the concepts of metal joining process, their applications and power transmission modes like belt drives, gears and gear trains
3. To make them understand the various building materials, their properties and selection
4. To teach them the basics of surveying, roads, water supply and sewage disposal

Course Outcome:

1. Apply the concepts of working principle of turbines in the power plants and also of the IC engines in the basic design of the vehicles
2. Have a basic knowledge of metal joining and power transmission and apply them in some basic requirements

3. Gain the knowledge of the materials required to develop a good infrastructure

4. Apply the basic idea about surveying, water supply and various methods for the disposal of sewage in their daily life

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME14F1100	**CO1**	**3**	**3**	**2**			**2**	**2**						**3**	**3**	**3**
	CO2	**3**	**3**	**3**				**1**						**3**	**3**	**3**
	CO3	**3**	**3**	**3**										**3**	**3**	**3**
	CO4	**3**	**3**	**2**										**3**	**3**	**2**

Course Content:

Unit–1: **12 hours**

Turbines- Introduction to turbines and prime movers, Classification of turbines, Working principle and applications of impulse and reaction steam turbines, gas turbines (open and closed cycle type) and water turbines (Pelton wheel, Francis and Kaplan), Compounding of impulse turbine

Internal Combustion Engines – Introduction, Classification of IC engines, parts of IC engine, Working principle of four stroke (petrol and diesel) and two stroke (petrol and diesel) engine, differences between 4 Stroke & 2 Stroke engines and Numerical problems on power and efficiencies.

Unit–2: **12 hours**

Metal joining processes- Introduction, classification of metal joining processes, method of welding (Electric Arc and Oxy acetylene welding), soldering and brazing and their differences and applications.

Power Transmission- Introduction to Transmission system and its classification, types of Belt Drives, Definitions of Velocity ratio, angle of contact Creep and slip, Idler pulley, stepped pulley, fast & loose pulley, simple problems

Gears - Definitions, Spur gear terminology, Types and applications of Gears

Gear Trains – Simple and compound gear trains, Simple problems on gear trains

Unit-3: **12 hours**

Introduction: Introduction to Civil Engineering - Scope of Civil Engineer – Branches of Civil Engineering – uses of Civil Engineering. Infrastructure – infrastructural facilities on socio – economic development of the country.

Building materials: Introduction – Civil Engineering – Materials: Bricks – classifications – properties –uses. Stone – classification of rocks – uses. Timber - properties –uses –ply wood. Cement – grades –types – properties –uses. Steel – types – mild steel – medium steel – hard steel – properties – uses – market forms. Concrete – grade designation – properties – uses.

Building components: Building – selection of site – classification – components. Foundations –functions – classifications – bearing capacity. Flooring – requirements – selection – types – cement concrete marble – terrazzo floorings. Roof – types and requirements.

Unit-4: **12 hours**

Surveying and transportation: Surveying – objectives – classification – principles of survey. Transportation

– Classification – cross section and components of road – classification of roads. Railway – cross section and components of permanent way –functions. Water way – docks and harbor – classifications – components.

Bridge – components of Bridge.

Water supply and sewage disposal: Dams – purpose – selection of site – types –gravity dam (cross section only). Water supply – objective – quantity of water – sources – standards of drinking water – distribution system. Sewage – classification – technical terms – septic tank – components and functions.

Text Books:

1. A Text Book of Elements of Mechanical Engineering – K.R. Gopalkrishna, Subhash Publishers, Bangalore.
2. Elements of Mechanical Engineering – Kestoor Praveen and M.R. Ramesh 2nd Edition 2011, Suggi Publications
3. Dr.B.C.Punmia , "Building Materials & Construction ", Laxmi Publications, New Delhi.
4. Rangwala .S.C," Engineering Material"s, Charotar Publishing House, Anand,

Reference Book:

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

WORKSHOP PRACTICE

Objectives:
1. To train students in metal joining process like welding, soldering etc.
2. To impart skill in fabricating simple components using sheet metal.
3. To cultivate safety aspects in handling of tools and equipment.

Outcomes: On completion of this course, the students will be able to
1. Welding and soldering operations.
2. Fabrication of simple sheet metal and wood parts.

Unit I-Welding Shop
1. Instruction of standards and reading of welding drawings.
2. Making Butt joint, Lap joint, Corner joint.

Unit II Sheet Metal and Soldering shop
1. Making of Cube, Prism, Cone, Cylinder, and Funnel using development of lateral surfaces.
2. Instruction of standards and reading of soldering tools.
3. Soldering of sheet metal models

Unit III Fitting/Carpentering
1. Making of Cube, Prism, Cone, Cylinder, and Funnel using development of lateral surfaces.
2. Instruction of standards and reading of soldering tools.
3. Soldering of sheet metal models.

Unit IV BOSCH Tools
1. Demonstration of all BOSCH tools and their applications.
2. Workshop Manual Prepared by REVA University Staff

SECOND SEMESTER

Course Title	**ENGINEERING MATHEMATICS-II**		
Course Code	BTME14F2100	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

Course Objectives:

To study and understand the application approach of the concepts of Vector calculus, differential and partial differential equations, complex variables, advanced calculus and Special functions.

Course Outcome:

1. This part extend our ability to analyze motion problems from real lines to curves and surfaces in 3-D. Tools such as directional derivatives, divergence and curl of vector and gradient play significant roles in many applications.
2. Application of integral calculus includes finding area of irregular plane regions, length of curve, moment of inertia, center of gravity
3. Multiple integral is a natural extension of a definite integral to a function of two, three variables and are useful in evaluating area, volume, mass, centroid of plane.
4. This part extends our ability to analyze differential equations. The students become familiar with the applications of differential equations to engineering problems.

Course Code	**POS/ COs**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**P 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
BTEM14F2100	**CO1**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
	CO2	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
	CO3	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**
	CO4	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**

Course Content:

Unit-1:Vector Calculus: [6 hrs]

Derivative of a vector function of one variable.Velocity and acceleration – concept with examples. Scalar and vector point functions – Gradient, Divergence,Curl,Laplacian,Solenoidal and Irrotational vectors. Vector Identities,Orthogonal Curvilinear Coordinates – Definition, unit vectors, scale factors, orthogonality of Cylindrical and Spherical Systems. Expression for Gradient, Divergence, Curl, Laplacian in an orthogonal system and also in Cartesian,Cylindrical and Spherical System as particular cases – No problems

Unit-2: Ordinary and Partial Differential Equations: [22 hrs]

Solution of first order and first degree equations: Method of separation of variables, Homogeneous, Exact, Linear equations and reducible to these forms, orthogonal trajectories.

Linear differential equations: Solution of second and higher order equations with constant coefficients by inverse differential operator method. Simultaneous differential equations of first order. Method of variation of parameters, Solutions of Cauchy's and Legendre's linear equations, simple problems.

Formation of Partial differential equations (PDE) by elimination of arbitrary constants/ functions. Solution of non-homogeneous PDE by direct integration. Solution homogeneous PDE involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Solution of PDE by the Method of separation of variables (first and second order equations)

Unit-3: Complex Variables [14 hrs]

Function of a complex variable, Analytic functions-Cauchy-Riemann equations in cartesian and polar forms. Properties of analytic functions.Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines.Conformal Transformations: Bilinear Transformations.

Discussion of Transformations: $w = z^2$, $w = e^z$, $w = z + (a^2 / z)$ Complex line integrals-Cauchy's theorem and Cauchy's integral formula

Unit 4: [18 hrs]

Advanced Calculus and Special Functions: Integral Calculus: Differentiation under the integral sign – simple Problems with constant limits. Reduction formulae for the integrals of $\sin^n x$, $\cos^n x$, $\sin^m x \cos^n x$ and evaluation of these integrals with standard limits - Problems

Multiple Integrals – Evaluation of Double integrals and triple integrals. Evaluation of double integrals over a given region, by change of order of integration, by change of variables. Applications to area and volume ***Beta and Gamma Functions*****-** Properties and problems

Solution of Laplace equation in cylindrical and spherical systems leading Bessel's and Legendre's differential equations, Series solution of Bessel's differential equation leading to Bessel function of first kind, Series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers
2. Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.

Reference Books:

1. B.V. Ramana, Higher Engineering Mathematics, Latest edition, Tata Mc. Graw Hill Publications.
2. R.K.Jain and S.R.K.Iyengar : Advanced Engineering Mathematics, Narosa Publishing House, Latest Edition.

Course Title	**ENGINEERING CHEMISTRY**		
Course Code	BTME14F2200	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-0-1=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

Course Objectives:

2. To develop the basic knowledge of batteries and chemical fuels
3. To incorporate the concepts of Corrosion control & metal Finishing
4. To make them understand the polymers & phase rule
5. To teach them the basics of Corrosion & its control metal finishing

COURSE OUTCOME:

1. Determination of CV using bomb & Boy's calorimeter
2. Electrochemical theory, Types of corrosion
3. Gain the knowledge of Determination of different constituents in H2O-hardness, alkalinity
4. Apply the basic Electrochemical theory of corrosion

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME14F2200	**CO1**	**3**	**2**	**3**										**2**	**2**	**1**
	CO2	**2**	**2**	**2**										**2**	**2**	**1**
	CO3	**3**	**2**	**3**										**2**	**2**	**1**
	CO4	**3**	**2**	**2**										**2**	**2**	**1**

Course Content:

Unit-1: Batteries & Chemical Fuels **12 hours**

Introduction: Basic concepts, battery characteristics- primary, secondary and reserve batteries. Chemical Fuels – Introduction, classification, calorific value – HCV & LCV, Determination of CV using bomb & Boy's calorimeter – numerical problems. Petroleum cracking by fluidized catalytic cracking, Reformation of petrol, octane & cetane number, knocking-mechanism & harmful Effects. Anti-knocking agents. Aviation turbine fuels-Synthetic petrol, Nuclear Energy – Mass defect, Binding energy, nuclear fission, nuclear fusion. Lubrications-Mechanism of lubrication, classification - oil, semisolid grease, Synthetic lubricants & properties, Azeotropic Mixture. Photovoltaic cells - Construction & working of Photovoltaic cell.

Unit-2: Corrosion control & metal Finishing **12 hours**

Electrochemical theory, Types of corrosion-Differential metal corrosion, Differential Aeration corrosion,
Stress corrosion, Grain boundary corrosion, Crevice corrosion.Factors affecting - pilling bed worth role,
Energy concept (Pourbiance) under different pH conditions.Corrsion Studies on Al, Fe with phase diagram .Corrsion control: Inorganic coating -Anodizing & Phosphating, metal coating- galivanzing & tinning, corrosion inhibitors, cathodic protection, Anodic Protection.

Organic coatings-Chemical compositions-paints & Enamel, Role of secondary reference electrode in corrosion studies (calomel, Ag/Agcl, sat Cu / CuSo4)
Metal Finishing-Technological importance, significances of polarization. Decomposition potential

& Overvoltage in electroplating, theory of electroplating. Effect of plating variables on the nature of electrodeposit-electroplating process, electroplating of gold & chromium, Electro less plating of Cu & Ni.

Unit-3: Water Chemistry & Instrumental Methods **12 hours**

Introduction: Impurities in H2 O, Determination of different constituents in H2O-hardness, alkalinity**, Cl, F, NO3, SO4**, & DO. Sewage –BOD & COD, Numerical problems, Sewage treatment. Desalination of water – RO & Electro dialysis.

Instrumentation: Theory, instrumentation & App of colorimetry, Potentiometry, Conductometry & flame Photometry & Determination of pH ,Principles of chromatography,Glass -manufacturing ,properties ,types of glass.Cement-Classification, chemical composition of plaster of paris and portland cement. Ceramics-general properties and classification, hydroapatite.

Unit-4: Polymers & Phase Rule **12 hours**

Introduction: Types of polymerization-Addition and Condensation, Solubility, molecular weight determination, Ziegler's natta catalyst, glass transition temperature, Structure and Property relationship. Synthesis &Applications of -Bakelite, ABS, Nylon, PMMA. Adhesives-Synthesis and applications of epoxy resins. **Polymer composites-** Synthesis and applications of Kevlar and Carbon fibers conducting polymers-Definition, Mechanism of conduction in Polyacetylene &applications. Polymer liquid crystals, Biopolymers, Optical fibers, natural rubber & synthetic rubber.

PHASE RULE-Statement of Gibb's phase rule, explanation of terms, phase diagram of one component & two component system.

Unit-5: Corrosion & its control metal finishing: **12 hours**

Introduction: Electrochemical theory of corrosion: Types of Corrosion- Differential metal corrosion, Differential aeration corrosion (Pitting & water line) Stress corrosion (Caustic embattlement), Erosion corrosion, and Grain boundary corrosion crevice corrosion. Factors affecting rate of corrosion-Primary, secondary, pilling bed worth rule, Energy concept (Pourbiance) under different pH conditions. Corrosion Studies on Al, Fe with phase diagram. Corrsion control: Inorganic coating Anodizing & Phosphating, metal coating galvanizing & tinning, corrosion inhibitors, cathodic protection, Anodic Protection.Organic coatings-Chemical compositions-paints & Enamel, Role of secondary reference electrode in corrosion studies (calomel ,Ag/Agcl, sat Cu / Cuso4)

Metal Finishing: Technological importance, significances of polarization. Decomposition potential

Overvoltage in electroplating, theory of electroplating. Effect of plating variables on the nature of electrodeposit-electroplating process, electroplating of gold & chromium, Electro less plating of Cu & Ni.

Text Books:

1. An Introductio to Corrosion & its engg,Wille publications,R.Wiston Revie & Herbert H.Uhlig
2. Polymer ScienceV.R.Gowariker,Wiley Eastern Ltd.
3. Principles of Electrochemistry, by Deken Pleutcher
4. Industrial Electrochemistry by Derek Plectches,Franck C Walsh
5. Corrosion Enggnering by Mars Guy Fontana
6. A text book of engineering chemistry P.C.Jain and Monica Jain Dhanpatrai Publications, New Delhi.

CHEMISTRY LAB

LAB EXERCISES

1. Potentiometric estimation of FAS using standard K2Cr2O7 solution

2. Conductometric estimation of an Acid mixture using standard NaOH solution
3. Determinatuion of pKa of a Weak acid using pH Meter
4. Determination of Viscosity co-efficient of a given liquid using Ostwald's Viscometer.
5. Determination of total hardness of a water using disodium salt of EDTA.
6. Determination of CaO in the given sample of Cemet by EDTA method.
7. Determination of COD of the given industrial waste water sample.
8. Determination of DO in the given water sample by Winkler's method.

BTME14F2300	**Constitution of Indian and Professional Ethics**	FC	**L**	**T**	**P**	**C**	**Hrs /week**
Duration:14 Wks			2	0	0	2	2

Prerequisites:

Pre-university level Constitution of India and Professional Ethics

Course Objectives:

1. To provide and gain knowledge on Constitution of India.
2. To know and understand about the Fundamental Rights, Duties
3. To prepare students in the understanding of Constitution perspective and make them face the world as a bonafide citizen.
4. To attain knowledge about ethics and also know about professional ethics and explore Ethical standard followed by different Companies.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Strengthen the knowledge on Indian Constitutional law and make the practical implementation of it.
2. Understand the Fundamental rights and Duties.
3. Adopt the habit of raising their voice against unconstitutionality of any laws and upon any legal discrimination as we have session of debates on Constitutional validity.
4. Get exposed about Professional ethics and know about etiquettes about it and know about ethical Standard of different Companies which will increase their Professional ability.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
B18 ME 2060	CO1						1	2	2		2		1			
	CO2						2	2	2		2		2			
	CO3						2	2	3		2		2			
	CO4						3	3	3		2		2			

Course Contents:

UNIT- I: Constitution of India
[6Hrs]

Definition, Making of Indian Constitution, Preamble to the Constitution of India, Fundamental Rights under Part III; Rights to Equality, Right to Freedom, Right against Exploitation, Rights to Freedom of Religion, Cultural and Educational Rights, Constitutional Remedies. Fundamental Duties of the Citizen, Significance and Characteristics. Elements of National Significance; National Flag, National Anthem, National Emblem.

UNIT- II: Union and State
[6Hrs]

Organs of the Government; Legislature, Executive and Judiciary. Union and State Executives: President, Vice President, Prime Minister, Supreme Court, Cabinet, Governor, Council of Ministers, Electoral process, Election Commission. Right to Information (RTI), Consumer and Consumer Protection.

UNIT- III: Ethics
[6Hrs]

Meaning, Definition, Evolution, Need of ethics, Aristotlean Ethics, Utilitarianism, Katianism, Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

UNIT- IV: Engineering Ethics
[6Hrs]

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

Text books:

1.M V Pylee, **An introduction to Constitution of India**
2. M Govindarajan, S Natarajan, V S Senthil Kumar, **Engineering Ethics-includes human values** PHI Learning-2004

Course Title	**COMPUTER PROGRAMMING SKILLS AND APPLICATIONS**		
Course Code	BTME14F2400	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-0-1=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

The objective of this course is to:

1. Introduce fundamentals of computer hardware and software;

2. Provide an understanding of problem solving with a computer;
3. Give an exhaustive hands-on exposure to the C programming language;
4. Familiarize the Unix programming environment;
5. Introduce problem solving by writing C programs and executing them in laboratory;

Course Outcome:

A student who successfully completes the course will have the ability to:

1. Explain the hardware and software organization of a computer system.
2. understand the basic terminology used in computer programming;
3. Use various Unix commands and their syntax
4. Write, compile and debug programs in C language;
5. Use different data types and operators in a computer program;
6. Design programs involving decision structures, loops and functions;
7. Use function call by value and function call by reference;
8. Use arrays in various applications like sorting and searching;
9. Handle strings, structures, unions and files in a C program;
10. Apply C language to solve a variety of problems in a practical way.

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME14F2400	**CO1**	**2**	**2**	**1**	**2**									**3**	**2**	**3**
	CO2	**2**	**2**	**1**	**2**									**3**	**2**	**2**
	CO3	**2**	**2**	**1**	**3**									**3**	**2**	**3**
	CO4	**2**	**2**	**1**	**2**									**3**	**2**	**2**
	CO5	**2**	**2**	**1**	**3**									**3**	**2**	**3**
	CO6	**2**	**2**	**2**	**2**									**3**	**3**	**2**
	CO7	**2**	**2**	**1**	**3**									**2**	**2**	**3**
	CO8	**2**	**2**	**2**	**3**									**3**	**3**	**3**
	CO9	**2**	**2**	**1**	**3**									**3**	**3**	**3**
	CO10	**2**	**2**	**2**	**2**									**3**	**3**	**3**

Course Contents:

Unit-1: Introduction to Computer System, Computer Organization, Hardware and Software: Definition of Computer, Early history, Structure of a computer, Information Processing life cycle, Essential computer hardware -

Microprocessors, Storage media, Essential computer software, Types and Functions of operating systems, Number systems, Computer processing techniques, Networking, Approaches to Problem Solving, Concept of algorithm and flow charts, Types of computer languages: Machine Language, Assembly Language and High Level Language, Concept of Assembler, Compiler, Loader and Linker. 12 hours

Unit-2: Getting started with UNIX – Introduction and Commands: Introduction to Unix Operating System, Introduction to Basic Command Format, Working with Files, Using the vi text editor, Working with Files and Directories, Filename Substitution and Wild Cards, Standard Input, Output and Error, Pipes and redirection, Shell Commands. 10 hours

Unit-3: Fundamentals of Problem Solving and Introduction to C Language:

Background, structure of a C Program, Input / Output, Programming example, Tips and common programming errors, Expressions and Statements, Selection, Components of C language. Standard I/O in C, Conditional program execution

Flow Control in C: Applying if and switch statements, nesting if and else, use of break and default with switch, use of while, do while and for loops, multiple loop variables, use of break and continue statements. 10 hours

Unit-4: More towards the C language:

Functions in C, Recursion, Single and multidimensional arrays, Strings, Introduction to pointers and data structures, File handling, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler. 10 hours

Text books:

1. B S Anami, S A Angadi and S S Manvi, Computer Concepts and C Programming, Prentice Hall of India Private Limited, 2007.
2. Das, Sumitabha; UNIX Concepts and Applications; 4th Edition; Tata McGraw Hill Education Private Limited.
3. Kernighan; Dennis Ritchie (March 1988). The C Programming Language (2nd Ed.), Englewood Cliffs, NJ: Prentice Hall. ISBN 0-13-110362-8.
4. Paul Deitel; C How to Program; 7th Edition; Deital How to Series.
5. Herbert Schildt, C: The Complete Reference; 4th Edition; Tata McGraw Hill Education Private Limited.

Computer Programming Lab

Lab Exercises:

1. Unix Commands – execution and learn extra options than what is taught in theory
2. How to edit, compile and execute a C program on UNIX.
3. Programs on data types, operators, expressions
4. Conditional statements – simple if statement, if-else statement, nested if-else, else-if ladder, switch statement
5. Looping statements – for, while and do-while statements
6. Arrays – 1-D and 2-D arrays
7. Sorting and searching

8. User defined Functions – pass by value, pass by reference, passing arrays to functions
9. Strings – finding length, string concatenation, string compare, substring search, palindromes etc.
10. Error debugging exercises
11. File handling exercises

Course Title	**Computer Aided Engineering Drawing**		
Course Code	BTME14F2500	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-0-1=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

Preamble:

Any Engineer, irrespective of his branch of specialization, has to have certain knowledge in order to design and manufacture any product for usage of society. One of the most important knowledge lies in Engineering Drawing. Engineers are a special class of professionals who employ the art and science of dreaming image as a means of communication. Engineering drawing is the primary medium for communicating design concepts and is an important tool for analyzing engineering problems. This course aims at developing the skills needed for documenting designs using drawings and for performing graphical analysis of two dimensional. Manual and computer aided methods of drawings and communication are covered.

Course Objectives:

1 Comprehend general projection theory, with emphasis on orthographic projection to represent in two-dimensional views (principal, auxiliary, sections).
2 Dimension and annotate two-dimensional engineering drawings.
3 Understand the application of industry standards and best practices applied in engineering graphics.
4 Emphasize freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.
5 Introduction of CAD software for the creation of 2D engineering drawings.
6 The theoretical concepts delivered in this course would help the students to understand the sign considerations and tolerances to be used in the design and manufacture of engineering components.
7 This course will be very much basics for students to learn and wisely apply for the advanced Computer Aided Engineering (CAE) tools such as ABAQUS, ANSYS etc.

Course Outcome:

1 Be industry ready
2 Be able to develop independent thinking and problem solving capabilities
3 Be able to express component descriptions as per the commonly practiced standards
4 Be able to produce 2D and simple 3D drawings
5 Be able to comprehend industry specific drawings

6 Be able to converse through computer aided drawing any objects/tools/instruments/elements/ structures belonging to the entire engineering field
7 Be able to produce simple clear and illustrative drawings as per existing standards/conversations.

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME14F2500	**CO1**	**1**	**3**	**2**										**2**	**3**	**2**
	CO2	**1**	**2**	**2**										**2**	**3**	**2**
	CO3	**1**	**2**	**2**										**2**	**3**	**2**
	CO4	**1**	**3**	**2**										**2**	**3**	**2**
	CO5	**1**	**2**	**2**										**2**	**2**	**2**
	CO6	**1**	**3**	**2**										**2**	**2**	**2**
	CO7	**1**	**3**	**2**										**2**	**2**	**2**

Course Content:

Unit–1:

Introduction to Drawing: Introduction to Engineering Drawing: Introduction, Drawing Instruments and their uses, BIS conventions, Drawing sheets, Lettering, Dimensioning, Scales, regular polygons and its methods, tangents, ellipse, parabola, hyperbola, loci, cycloids, trochoids, epi and hypocycloids, spirals and involutes, helix, Co-ordinate system and reference planes.
Introduction to Software (solid edge): Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend to next ,split, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, material conventions and lettering.
Orthographic Projection: Projection – Orthographic Projection – Planes of Projection – Four quadrants – First-angle projection – Third-angle projection – Reference line – Conventions employed.
Projection of points: Points in different quadrants.

Projection of Straight Lines (First-angle Projection only): Parallel to one or both planes – Contained by one or both planes – Perpendicular to one plane and parallel to other plane – Inclined to one plane and parallel to the other – Inclined to both planes.

Projection of Planes: Types of Planes – Perpendicular Planes – Oblique Planes – Projection of Planes - Parallel to one Plane – perpendicular to both planes – perpendicular to one inclines to other – Oblique planes (only change of position method).

Unit–2:
Projection of Solids: Polyhedra (Cube – Tetrahedron - Prisms and Pyramids) – Solids of revolution(Cone and Cylinder) – Solids in simple position – Axis perpendicular to a plane – Axis parallel to both planes – Axis parallel to one plane and inclined to the other – Axis inclined to both plane (only change of position method).

Unit–3:

Sections of Solids: Section Planes – Sections – True Shape of Section – Sections of Prisms – Sections of Pyramids – Sections of Cylinders – Section of Cones.

Developments of Lateral Surfaces of Solids - Polyhedra (Cube – Tetrahedron - Prisms and Pyramids) – Solids of revolution (Cone and Cylinder) and their Frustums.
Unit – 4

Isometric Projection: Isometric axes - Lines and Planes – Isometric Scale – Isometric Projection of Planes – Prisms – Pyramids – Cylinders – Cones – Spheres - Hemi-Spheres - frustums - Combination of Solids (Maximum Three). Conversion of Orthographic Drawing to Isometric View / Pictorial Drawing of a simple Machine Components. Application Drawings: Civil drawing (building plans), electrical symbols and circuits, electronic symbols and circuits and simple assembly drawing (bolt and nut).

Text Books:

1. Engineering Drawing – N.D.Bhatt and V.M. Panchal, 48th Edition, 2005 – Charotar Publishing House, Gujarat.
2. A Primer on Computer Aided Engineering Drawing-2006, Published by VTU, Belgaum.

Reference Books:

1. Engineering Graphics - K.R. Gopalakrishna, 32nd Edition, 2005 – Subhas Publishers, Bangalore.
2. Engineering Drawing – P. S. Gill, 11th Edition, 2001 – S. K. Kataria & Sons, Delhi.

Course Title	**ENGINEERING MECHANICS**		
Course Code	BTME14F2600	**IA Marks**	: 25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	**Exam Hrs**	: 3
Total No. of Contact Hrs per Week	3-2-0=5	**Exam Marks**	: 50

Course Objectives:

1. To enable students to establish a broad concept of Engineering Statics
2. To enable students to understand the basics of Composition of Coplanar Forces
3. To provide an overview of Centroid of Plane Area & Moment of Inertia of a Plane Area.
4. To introduce the concept of Introduction to Engineering Dynamics
5. To enable students to understand the concepts of dry friction.

Course Outcome:

1. Be able to describe the moment of forces and couples and equivalent force-couple systems
2. Be able to solve Numerical problems on composition of coplanar non-concurrent force systems
3. Be able to Locating the centroid of triangle, semicircle, quadrant of a circle and sector of a circle using method of integration, Centroid of composite sections
4. Be able to solve simple Concept of free body diagram, Numerical problems on equilibrium of coplanar.
5. Be able to relate the applications of Kinematics and Kinetics

Course Code	**POS/ COs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**P7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
BTME14F2600	**CO1**	**3**	**3**	**2**										**3**	**3**	**3**
	CO2	**3**	**3**	**3**										**3**	**3**	**2**

	CO3	**3**	**3**	**3**									**3**	**2**	**2**
	CO4	**3**	**3**	**3**									**3**	**2**	**2**
	CO5	**3**	**2**	**3**									**3**	**2**	**3**

Unit-1:

Introduction to Engineering Statics: Newtonian Mechanics, Basic idealizations - Particle, Continuum and Rigid body; Force and its characteristics, types of forces, Classification of force systems; Principle of physical independence of forces, Principle of superposition of forces, Principle of transmissibility of force; Newton's first and third laws of motion, Introduction to SI units, Moment of a force, moment of a couple, characteristics of couple, Equivalent force-couple system; Resolution of force, composition of forces; Numerical problems on moment of forces and couples and equivalent force-couple systems.

Composition of Coplanar Forces: Definition of Resultant, Composition of coplanar-concurrent force system, Numerical problems on composition of coplanar concurrent force systems. Varignon's principle of moments, Composition of coplanar-non-concurrent force system, Numerical problems on composition of coplanar non-concurrent force systems [14 hrs]

Unit-2:

Centroid of Plane Area: Locating the centroid of triangle, semicircle, quadrant of a circle and sector of a circle using method of integration, Centroid of composite sections; Numerical problems.
Moment of Inertia of a Plane Area: Rectangular and polar moments of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem; Moment of Inertia of rectangle, circle, semi-circle and quarter circle and triangle from first principles (method of integration); Moment of inertia of composite areas; Numerical problems. [13 hrs]

Unit-3

Equilibrium of Coplanar Forces: Definition of static equilibrium and equilibrant, Conditions of static equilibrium for different coplanar force systems, Lami's theorem, Concept of free body diagram, Numerical problems on equilibrium of coplanar–concurrent and non-concurrent force systems.
Support Reactions: Types of supports, statically determinate and indeterminate beams, Numerical problems on support reactions for statically determinate beams.

Dry Friction: Types of friction, Laws of static and kinetic friction, Limiting friction, Angle of static and kinetic friction, angle of repose; Numerical problems on impending motion of a body on horizontal and inclined planes, wedge friction, ladder friction. [14 hrs]

Unit–4

Introduction to Engineering Dynamics: Kinematics and Kinetics. Newton's second law of motion, Newton's law of gravitation, Concept of dynamic equilibrium and D'Alembert's Principle, Principle of Virtual Displacement. Kinematics of rectilinear and curvilinear motions of a particle including the concept of relative motion, Simple numerical problems. Kinetics of rectilinear and curvilinear motions of a particle. Simple numerical problems. [13 hrs]

Text Books:

1. Mechanics for Engineers – Statics by Beer and Johnston, McGraw-Hill Book Company,
2. Mechanics for Engineers – Dynamics by Beer and Johnston, McGraw-Hill Book Company
3. Engineering Mechanics – Statics by Hibbeler
4. Engineering Mechanics – Dynamics by Hibbeler

5. Engineering Mechanics by S.Timoshenko, D.H.Young, and J.V.Rao, TATA McGraw-Hill Book Company, New Delhi.

Reference Books:

1. Engineering Mechanics B.Bhattacharryya, Oxford University Press 2008, Delhi.
2. Engineering Mechanics by K.L. Kumar, Tata McGraw-Hill Publishing Company, New Delhi.
3. Engineering Mechanics by MVS Rao and D.R.Durgaiah. University Press (2005), Delhi
4. Engineering Mechanics by Nelson, Tata McGraw Hill Education India Pvt Ltd., New Delhi.
5. Engineering Mechanics by S.S. Bhavikatti and Rajashekar,

DETAILED SYLLABUS

SEMESTER-III

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F3100	**Engineering Mathematics – III**	16	HC	3	1	0	4	5

Prerequisites:

Course Objectives: To study and understand the application approach of the concepts of Numerical methods, Probability, random variables and Sampling distributions in various fields of engineering.

Course Outcomes:

After the completion of the course the student will

1. To understand the basics of numerical methods and their applications.
2. To solve the problems of Probability and statistics in various engineering fields.
3. To apply the numerical methods and Sampling Theory concepts to solve various engineering problems.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F3100	**CO1**	**3**	**3**		**2**	**2**									**2**	**1**
	CO2	**2**	**3**		**3**	**2**									**1**	**2**
	CO3	**3**	**2**		**2**	**3**									**2**	**1**

Course Contents:

Unit-1: [14 hrs]

Numerical Methods –I: Introduction, solution of algebraic and transcendental equation, Bisection method, Regula false method, Newton Raphson method.

Finite differences and Interpolation :-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 and Problems.

Unit-2: [14 hrs]

Numerical Methods –II: Numerical Differentiation and Integration: - Derivatives using Newton's forward and backward difference formula. Trapezoidal Rule, Simpson's $1/3^{rd}$, $3/8^{th}$ Rule, Weddle's formula and Problems.

Numerical solutions to ODE: (First order and first degree) Picards Method , Taylor's series method , Euler's method , Modified Euler's method , Runge-Kutta method of fourth order, Adam's-Bashforth Predictor-corrector method and Problems.

Unit-3: [14 hrs]

Introduction of Probability, Probability associated with set theory, addition law, conditional Probability, multiplication law, Baye's Theorem.

Random variables (discrete and continuous), Probability density function, probability distribution – binomial and Poisson's distributions; exponential and normal distributions.

Unit-4: [14 hrs]

Sampling theory:-Sampling, Sampling distributions, standard error, test of hypothesis for means and confidence limits for means and distributions and Chi-square distributions.

Joint Probability distribution and Markov's chains:-Concept of joint probability, joint distributions –discrete random variables, independent random variables, problems on expectation and variance.

Markov's chains-Introduction, probability vectors, stochastic matrices, fixed points and regular stochastic matrices, Markov's chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42^{nd} edition, 2013.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9^{th} edition, 2012.

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 1^{st} Edition, 2010.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing

House, 4th edition, 2002.

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F3200	**MATERIAL SCIENCE**	16	HC	3	0	0	3	3

Objectives:

1. The main objective of this course is to provide the basic knowledge required to explore the discipline of materials science and engineering.
2. To develop the knowledge of the structure of materials which includes crystallography, microstructure, defects, and phase diagrams
3. To give an idea about the heat treatment required for the metals
4. To incorporate the knowledge in various class of materials and their applications

Expected Outcome: Student will be able to

1. Understand how materials are classified based on atomic arrangement and behavoir of materials in elastic and plastic regions
2. Identify the type of failures and also to perform fatigue test
3. Identify the different phases of iron and apply required heat treatment process for the industrial purposes
4. Gain knowledge on different class of materials and their applications

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F3200	**CO1**	**2**	**2**			**1**					**1**	**2**		**3**	**2**	**2**
	CO2	**3**	**2**			**3**					**2**	**2**		**2**	**2**	**2**
	CO3	**2**	**3**			**2**					**2**	**2**		**3**	**3**	**2**
	CO4	**3**	**1**			**1**					**3**	**1**		**2**	**2**	**3**

Unit-1: Crystal Structure: **[14 hrs]**

Types of crystal structures and their coordination number and atomic packing factors, lattice systems, crystal imperfections -point line and surface imperfections. Atomic Diffusion: Ficks laws of diffusion, factors affecting diffusion.

Stress-strain diagrams for ductile and brittle materials, linear and nonlinear elastic behavior, mechanical properties in plastic range, offset yield strength, ductility, toughness, and Plastic deformation of single crystal by slip and twinning.

Unit–2: **[14 hrs]**

Creep: phenomenon with examples, stages of creep, creep properties, stresses relaxation. Fatigue: Types of fatigue loading, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram. Ductile and brittle fracture

Solidification**:** Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, Solid solutions Hume Rothary rule, substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase rule. Phase diagrams I for one component and two component systems

Unit-3: Phase Diagram II: **[14 hrs]**

Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram, solidification of steels and cast irons, invariant reactions.
Heat treatment of metals**:** TTT curves, continuous cooling curves, annealing and its types. Normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys

Unit-4: Ferrous and nonferrous materials: [14 hrs]

Composition, properties and applications of Grey cast iron, malleable iron, SG iron and steel, Copper alloys-brasses and bronzes, Aluminium alloys-Al-Cu,Al-Si,Al-Zn alloys.
Composite Materials: classification, types of matrix materials & reinforcements, Intermetallic compounds-Polymers – thermosetting and thermoplastics, production of FRP's and MMC's, advantages and application of composites.

Text Books:

1. Foundations of Materials Science and Engineering, Smith, 4th Edition McGraw Hill, 2009
2. Materials Science, Shackleford., & M. K. Muralidhara, Pearson Publication – 2007.

Reference Books:

1. An Introduction to Metallurgy; Alan Cottrell, Universities Press India Oriental Longman Pvt. Ltd., 1974.
2. Engineering Materials Science, W.C.Richards, PHI, 1965
3. Materials Science and Engineering, V.Raghavan , PHI, 2002
4. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F3300	**STRENGTH OF MATERIALS**	16	HC	3	1	0	4	5

Objectives: The course should enable the students to

1. Gain knowledge of simple stresses, strains and deformations components due to external loads.
2. Assess stresses and deformations through mathematical models of beams, twisting bars or combination of both.
3. Provide the Basic knowledge for use in the design courses.

Expected outcome: The students should be able to

1. Understand the basic principles of structural elasticity, including statically determinate and indeterminate systems, and the factors which affect their strength and stiffness.
2. Assess the strength and stiffness of simple structural components.
3. Apply the effect of stress and deformation concepts in practical applications.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F3300	**CO1**	**2**	**3**	**3**		**2**					**3**	**2**		**2**	**3**	**3**
	CO2	**2**	**2**	**2**		**2**					**2**	**1**		**2**	**2**	**3**
	CO3	**2**	**3**	**3**		**1**					**3**	**2**		**2**	**3**	**2**

Unit-1: [14 hrs]

Simple Stresses & Strains: Concept & types of loads, Stresses and Strains, Poison's ratio, stress strain diagrams for ferrous and nonferrous materials, Hooks law, stresses and strains in simple and compound(includes varying cross sections) bars under axial loading, Principle of super position, elastic constants & their relationships, temperature stresses & strains in simple bars under axial loading, Numericals

Unit-2: [14 hrs]

Compound stresses and strains: Introduction, volumetric strains, two dimensional stress system, Plane stress, stresses on inclined sections, conjugate shear stress at a point on a plane, Principal stresses and planes-Mohr's circle representation of plane stress, Numericals

Torsion : Shafts, Torsion of Shafts, Torsion equation, Hollow Circular Shafts, Torsional Rigidity/Stiffness, Power Transmitted by the Shaft, Importance of Angle of Twist and Shear Stresses in Shafts, comparison of Solid and Hollow Shafts, Numericals

Unit-3 [14 hrs]

Shear Force And Bending Moment Diagram: Introduction, types of beams, loads and reactions,shear forces and bending moments, rate of loading, sign conventions, relationship between shearforce and bending moments, shear force and bending moment diagrams for different beamssubjected to concentrated loads, uniform distributed load (UDL) and Uniformly VaryingLoad(UVL) for different types of beams. Numericals

Bending stress and Deflections of beams: Theory of Simple Bending (Bending equation/ Flexural Formula), Assumptions, Position of Neutral Axis, Section Modulus, Practical Applicationsof Bending Equation, Numericals (symmetrical section only). Beam Deflection, Relation between Slope, Deflection and Radius of Curvature, Slope and Deflection at a Section, Double Integration Method

Unit-4: **[14 hrs]**

Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formulae for the elastic buckling load, Eulers, Rankine, Gordom's formulae Johnson's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections, Numericals.
Stresses in cylinders: stresses in thin cylinders, changes in dimensions of cylinder, Thin cyliders and thick cylinders subjected to internal and external pressures, Thick cylinders Lame's equation and compound pipes, Numericals

Text Books:

1. "Mechanics of materials", in S.I. Units, Ferdinand Beer & Russell Johnstan, TATA Mc GrawHill- 2003.
2. "Strength of Materials", S.S.Bhavikatti, Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
3. "Mechanics of materials", James.M.Gere, Thomson, Fifth edition 2004.

Reference Books:

1. "Mechanics of Materials", by R.C.Hibbeler, Printice Hall. Pearson Edu., 2005
2. "Strength Of Materials ", by S Ramamrutham, R Narayana, Dhanphatrai publishing Co.Ltd.2003
3. Engineering Mechanics and Strength of Materials, by R K Bansal, 1 ed, Laxmi Publications-new Delhi (2004)
4. "Strength Of Materials", by Timoshenko.S.P Part 1,D.Van Nostrand company, Inc. Newyork

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F3400	**BASIC THERMODYNAMICS**	16	HC	3	1	0	4	5

Preamble:
Thermodynamics is the basic and fundamental subject in mechanical engineering. The subject deals with fundamentals of thermodynamics, various concepts, definitions and the laws governing the thermodynamic principles. The subject aims at having understanding of concept of work and heat, pure substances, entropy principle. The concepts of heat engine, heat pump and refrigeration are also included in the subject to enable the students for taking up challenging task in the real time application in research, industrial sector and public issues. The fundamental laws of ideal and real gases are also taught in the subject to develop the skill to analyze different types of engineering devices and develop the new technologies or devices which are most efficient and minimize the environmental issues. The study of various engineering devices and analytical calculations are also included in the subject to expose the students to more practical applications.
Subject learning objectives

1. To learn the fundamentals of thermodynamics and related concepts to understand the basic units and its measurement and thermodynamic principle.
2. To understand the concept of thermodynamic work, heat and the fundamental laws of thermodynamics.
3. To learn the basics of heat engine, heat pump, refrigerator and Carnot principle and their practical applications.
4. To understand the concept of entropy and behavior of pure substances and its importance in practical applications.
5. To study the behavior of Ideal gases and Real gase.

Course outcomes:

1. Students can able to analyze the principles of thermodynamics in engineering applications.
2. Able to calculate work, heat and other parameters involved in thermodynamic system during execution of process or cycle.
3. Analysis of various systems under different circumstances in thermodynamic point of view.
4. Able to find performance of engineering devices like heat engine, heat pump and refrigerator.
5. Behavior of working fluid in various thermodynamic systems.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F3400	**CO1**	**3**	**2**	**2**	**2**			**2**				**2**		**3**	**2**	**2**
	CO2	**2**	**2**	**3**	**2**			**2**				**1**		**2**	**3**	**1**
	CO3	**2**	**2**	**3**	**2**			**3**				**2**		**3**	**3**	**2**
	CO4	**3**	**3**	**2**	**2**			**2**				**2**		**2**	**2**	**2**
	CO5	**2**	**2**	**2**	**2**			**2**				**1**		**3**	**2**	**2**

Unit-1: **[14 hrs]**

Fundamental Concepts & Definitions

Thermodynamics; definition and scope. Some practical applications of engineering thermdynamics. Microscopic and Macroscopic approaches. Thermodynamics System, closed system and open system; examples. Thermodynamic properties; definition and units, intensive and extensive properties. Thermodynamic state, path and process, path and point function, quasi-static process, cyclic and non-cyclic processes; Thermodynamic equilibrium; definition, mechanical equilibrium; thermal equilibrium, chemical equilibrium- Zeroth law of thermodynamics, Temperature; concepts, scales and measurement

Energy and Work Transfer

Energy definition, mechanical energy, kinetic energy, potential energy, internal energy. Heat: definitions, units, sign convention, specific heats. Work: Mechanics-definition of work and its

limitations, thermodynamic definition of work, sign convention. Displacement work, expressions for displacement work in various processes through p-v diagrams. Other forms of work. Similarity and dissimilarity between work and heat.

Unit-2: **[14 hrs]**

First Law of Thermodynamics

Joule's experiments, equivalence of heat and work. Statement of the First law of thermodynamics, First law apply to non –cyclic and non-flow processes, energy as a property, Specific heat at constant volume, enthalpy, specific heat constant pressure. Extension of the First law to flow processes (control volume); steady state-steady flow energy equation, important applications. PMMK-I.

Second Law of Thermodynamics

Devices converting heat to work. Thermal reservoir. Direct heat engine; schematic representation and efficiency. Second law of Thermodynamics; Kelvin -Planck statement, PMM II. Devices converting work to heat in a thermodynamic cycle; reversed heat engine, refrigerator and heat pump, schematic representation, coefficients of performance. Second law of Thermodynamics; Classius's statement, Equivalence of the two statements; Reversible and irreversible processes; reversible heat engines, Carnot cycle, Carnot principles. Thermodynamic temperature scale.

Unit-3: **[14 hrs]**

Entropy

Definition, Clasius theorem, Clasius inequality; statement, proof, application to a reversible cycle. . Entropy; a property, principle of increase of entropy, entropy as a quantitative test for irreversibility, calculation of entropy using Tds relations, entropy as a coordinate. Available and unavailable energy.

Ideal Gases & Ideal Gas Mixtures

Ideal gas; equation of state, internal energy and enthalpy as functions of temperature only, universal and particular gas constants, specific heats, perfect and semi-perfect gases. Evaluation of heat, work, change in internal energy, enthalpy and entropy in various quasi-static processes. Ideal gas mixture; Dalton's law of additive pressures, Amagat's law of additive volumes, evaluation of properties. Analysis of various processes.

Unit-4: **[14 hrs]**

Real Gases

Introduction; Vander Waal's Equation Van der Waal's constants in terms of critical properties, law of corresponding states, compressibility factor; compressibility chart.

Pure substance: P-T and P-V diagrams, triple point and critical points, subcooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of a pure substance with water as example. Enthalpy of change of phase (Latent heat),

dryness fraction, T-S and h-s diagrams, representation of various processes on these diagrams, throttling calorimeter, separating and throttling calorimeter.

Text Book:

1. Rajput R.K, Thermal Engineering. Lakshmi publications.
2. Nag P.K. Basic & Applied Thermodynamics. Tata McGraw Hill Pub. Co. 2002.

Reference Book:

1. Mahesh M Rathore, Thermal Engineering. Tata McGraw-Hill, Prentice-hall of India Pvt. Ltd.
2. Yunus A. Cenegal and Michael A. Boles, Thermodynamics -An Engineering Approach. Tata McGraw-Hill.2002.
3. G J Van Wylen and R E Sonntag, Fundamental of Classical Thermodynamics- Wiley Eastern.1st edition,2002

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F3500	**COMPUTER AIDED MACHINE DRAWING**	16	HC	1	0	2	3	7

Objectives: The aim of this course is

1. Understand drawing and develop capacity to represent any matter/object with the help of picture.
2. Develop primary knowledge of working drawing.
3. Produce orthographic drawing of different machine parts.
4. Develop skill to produce assembly drawings.

Expected Outcome:

1. Capability of understanding the graphical language.
2. Draw detailed schematic and simplified drawings in sections and elevation using ANSI standards.
3. Be able to analyze and design common machine elements.
4. Become more familiar with the range and function of common machine elements. Students should be able to apply this knowledge to generating new, innovative design

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F3500	**CO1**	**2**	**2**	**3**		**3**					**2**			**3**	**2**	**2**
	CO2	**1**	**2**	**2**		**2**					**2**			**3**	**2**	**2**
	CO3	**2**	**2**	**3**		**3**					**2**			**3**	**2**	**3**
	CO4	**2**	**1**	**2**		**2**					**1**			**2**	**2**	**2**

Unit–1: Introduction to Geometrical Tolerance and Dimensioning (GD&T) [14 hrs]

Orthographic Views: Conversion of pictorial views into orthographic projections of **simple machine parts** with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings).

Thread Forms: Thread terminology, sectional views of threads: ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.

Unit-2: **[21 hrs]**

Fasteners: Orthographic projection of Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly).

Keys & Rivetted Joints: Parallel key, Taper key, Feather key, Gibhead key and Woodruff key. Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets).

Unit-3: **[28 hrs]**

Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.

Couplings: Split Muff coupling, Protected type flanged coupling and Oldham's coupling and universal coupling (Hooks' Joint)

Unit–4: **[42 hrs]**

Assembly Drawing: Screw jack (Bottle type), Machine vice, Plummer block (Pedestal Bearing), I.C. Engine connecting rod, Tailstock of lathe, Tool Head of a shaper, Rams Bottom Safety Valve.

Text Books:

1. '**Machine Drawing**', N.D.Bhat & V.M.Panchal

Reference Books:

1. '**A Primer on Computer Aided Machine Drawing**', VTU Publication.
2. **'CAD for engineers and designers'**, Sham Tickoo. Dream tech 2005

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F3600	**MANUFACTURING TECHNOLOGY – I**	16	HC	3	0	0	3	3

Objectives:

1. To gain theoretical and practical knowledge in material casting processes and develop an understanding of the dependent and independent variables which control materials casting in a production setting.
2. To study how to select appropriate production processes for a specific application.
3. Introduce students to good foundry practices and product design considerations.
4. To know the fundamentals of joining processes and non-destructive testing

Outcomes:

Learner should be able to ……

1. Demonstrate understanding of non-chip forming processes such as casting, forging, metal joining, etc.
2. Understand basics of metallurgy of welding.
3. Identify the role of Non Destructive Techniques in production processes.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F3600	**CO1**	**2**	**2**		**2**	**3**						**2**	**2**	**3**	**2**	**2**
	CO2	**2**	**2**		**1**	**2**						**2**	**3**	**2**	**2**	**1**
	CO3	**2**	**2**		**2**	**2**						**2**	**2**	**2**	**2**	**2**

Unit-1: Patterns and Pattern making (06 hrs)

Introduction to Foundry – Classification of manufacturing process, Steps involved in casting, advantages, limitations and applications of casting process. Pattern types, allowances for pattern, pattern materials, color coding and storing of pattern

Moulding (06 hrs)

Sand Moulding : Base sand, Requirements of base sand, Methods of Moulding, Binder and additives, Methods of preparation of moulding sand, Different types of sand mix for sand moulds, properties of moulding sand, Types of sand moulds, Special moulding methods, Moulding Machines : Jolt type, Squeeze type, Jolt & Squeeze type and Sandslinger

Unit-2: Core making (06 hrs)

Cores: Definition of core, Core binder, Requirements of core sand, Types of cores, core making process, classification of cores, Equipment for baking of cores.

Metal moulds: Metallic moulds, Types of metallic mould castings: Gravity mould castings, pressure die castings, Centrifugal castings, Slush castings, Squeeze castings, Thixo casting, and Continuous casting. Concept of Gating, risering, Fettling and cleaning of castings

Melting Furnaces (06 hrs)

Selection of melting furnace, Classification of melting furnaces, Constructional features & working principle of coke fired, oil fired and Gas fired pit furnace, Resistance furnace, Crucible furnace, Cupola furnace, Induction furnace, Electric arc furnace, calculation of cupola charges-Degasification, inoculation, pouring techniques, casting defects and Inspection of castings.

Unit-3: Welding (06 hrs)

Welding process: Definition, Principles, Classification, Application, Advantages & limitations of welding. Gas welding Principle, Oxy – Acetylene welding, Chemical Reaction in Gas welding, Types of flame and Flame characteristics.

Electric Arc welding: Striking an Arc, Arc welding parameters, Classification of Arc welding, MAW, FSMAW, TIG, MIG, SAW, Arc welding current and voltage, Arc welding equipments, Comparison of AC and DC welding.

Special Welding: Resistance welding - principles, Seam welding, Butt welding, Spot welding and projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding, ultrasonic beam welding. **(06 hrs)**

Unit-4: Metallurgy of welding (06 hrs)

Metallurgical aspects in welding, Structure of welds, Formation of different zones during welding. Heat affected zone (HAZ). Parameters affecting HAZ, shrinkage and residual stresses in welding, weldability, Welding defects

Soldering and Brazing

Principles of soldering & brazing: Parameters involved & Mechanism, Different Types of Soldering & Brazing Methods.

Inspection Methods – Methods used for Inspection of casting and welding-Visual, Magnetic particle, Fluorescent particle, Ultrasonic, Radiography, Eddy current, Holography methods of Inspection, welding of special materials – Stainless steel, Aluminium etc. weldability of cast iron, steel, stainless steel, aluminium alloys

Text Books:

1. "Manufacturing Process-I", Dr.K.Radhakrishna, Sapna Book House, 5th Revised Edition 2009.
2. "Manufacturing Technology: Foundry Forming and Welding", P.N.Rao, 3rd Ed., Tata McGraw Hill, 2003.

Reference Books:

Process and Materials of Manufacturing", Roy A Lindberg, 4th Ed. Pearson Edu. 2006.

1. "Manufacturing Technology", Serope Kalpakjian, Steuen. R. Sechmid, Pearson Education Asia, 5th Ed. 2006.
2. Heine, Loper and Rosenthal, "Principles of Metal Casting", Tata Mc Graw Hill Publishing Co, Ltd; New Delhi, 1995.
3. Doehler.E.H, "Die Casting", McGraw Hill Book Co. New York.1991.
4. Banga T.R; and Agrawal R.L, "Foundry Engineering", Khanna Publishers, 1992.
5. Serope Kalpakjian, Steven R.Schmid, "Manufacturing Engineering and Technology". (4th Edition), Prentice Hall 2000-06-15 ISBN:0201361310
6. Gupta R.B, "Foundry Engineering"Satyaprakashan, 1989.
7. Lal, Mand Khanna O.P A, "Text Book of Foundry Technology", Dhanpat Rai and Sons, 1986.
8. Jain P.L, "Principles of Foundry Technology", Tata Mc Graw Hill Publishing Company, Ltd; 1995".

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F3700	**MATERIAL SCIENCE LAB**	16	HC	1	0	1	2	4

Objectives:

1. To prepare the specimen for metallographic examination
2. To study the wear characteristics of the given specimen
3. To study the tensile , compressive and shear prosperities of metals and non-metals
4. To evaluate Brinel, Vicker's and Rockwell's hardness of the materials
5. To find impact strength of the given material
6. To find the endurance limit of the material

Outcomes:

Learner should be able to ……

1. Identify the type of material based on the microstructure using optical microscope.
2. Evaluate the wear properties.
3. Determine the defects in the given specimen using Ultrasonic flaw detection, Magnetic crack detection and Dye penetration test.
4. Determine tensile, compressive, torsional and bending properties of the given material using UTM.
5. Determine hardness of the given material & impact strength of the given material

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F3700	**CO1**	**3**	**2**			**2**					**2**	**2**		**3**	**2**	**2**
	CO2	**2**	**3**			**2**					**2**	**3**		**2**	**3**	**2**
	CO3	**2**	**2**			**2**					**2**	**2**		**3**	**2**	**1**
	CO4	**2**	**1**			**1**					**2**	**2**		**3**	**2**	**2**
	CO5	**2**	**2**			**2**					**1**	**2**		**2**	**2**	**2**

PART – A

1. Preparation of specimen for Metallograpic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2. To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.
3. Non-destructive test experiments like,
   a) Ultrasonic flaw detection
   b) Magnetic crack detection
   c) Dye penetration testing. To study the defects of Cast and Welded specimens

PART – B

1. Tensile, shear and compression tests of metallic and non metallic specimens using Universal Testing Machine
2. Torsion Test
3. Bending Test on metallic and nonmetallic specimens.
4. Izod and Charpy Tests on M.S, C.I Specimen.
5. Brinell, Rockwell and Vickers's Hardness test.
6. Fatigue Test.

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F3800	Manufacturing Technology Lab	16	HC	1	0	1	2	4

Objectives:

1. The course will introduce desirable properties of molding sand and establish its relevance in preparing the sand mold.
2. To introduce the experimental procedure in determining the GFN, Permeability, Strength of mold, moisture & clay content in sand sample, core hardness & mold hardness.

3. To bring in the effect of clay & water content on the various properties of molding sand.
4. To give students hands on practice in preparing the sand moulds (Cope & Drag box) using single piece, split pattern and without using pattern.
5. To give students hands on practice in preparing forging models using open -hearth furnace by performing upsetting, drawing & bending operation

Outcomes:

Learner should be able to ……

1. Describe general properties of molding sand.
2. Determine the compression, shear, tensile strength & permeability of molding sand for different proportion of clay.
3. Identify the different tools used in foundry & Forging practice with their uses
4. Create the sand mold cavity using cope & drag box with pattern or without pattern
5. Demonstrate the upsetting, drawing & bending operation in preparing the forged model
6. Prepare the document based on the experiment/test conducted.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F3800	**CO1**	**2**	**2**		**2**	**3**					**2**		**2**	**3**	**2**	**2**
	CO2	**2**	**2**		**2**	**2**					**2**		**2**	**2**	**2**	**2**
	CO3	**2**	**2**		**1**	**2**					**2**		**2**	**3**	**2**	**2**
	CO4	**2**	**2**		**2**	**1**					**1**		**1**	**3**	**2**	**2**
	CO5	**2**	**1**		**2**	**2**					**1**		**2**	**2**	**2**	**2**
	CO6	**-**	**-**		**-**	**-**					**3**		**1**	**1**	**1**	**1**

PART – A

1. **Testing of Moulding sand and Core sand** Preparation of sand specimens and conduction of the following tests:
2. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
3. Permeability test
4. Core hardness & Mould hardness tests.
5. Sieve Analysis to find Grain Fineness number of Base Sand
6. Clay content determination in Base Sand

PART – B

2. Foundry Practice

Use of foundry tools and other equipments. Preparation of moulds using two moulding boxes using patterns or without patterns. (Split pattern, Match plate pattern and Core boxes). Preparation of one casting (Aluminum or cast iron-Demonstration only)

PART – C

3. Forging Operations:

1. Calculation of length of the raw material required to do the model.
2. Preparing minimum three forged models involving upsetting, drawing and bending operations.
3. Out of these three models, at least one model is to be prepared by using Power Hammer.

SEMESTER-IV

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F4100	**THEORY OF MACHINES – I**	16	HC	3	1	0	4	5

Objectives:

1. To familiarize students with basic types of mechanisms, joints and degrees of freedom to Perform position, velocity and acceleration analysis using graphical and analytical methods.
2. To provide students an understanding of different types of mechanisms.
3. To teach the basics of synthesis of simple mechanisms.
4. To teach students the kinematic analysis of cam-follower motion and gear train configurations.

Expected Outcome:

Student will be able to

1. Demonstrate an understanding of the concepts of various mechanisms and pairs.
2. Do velocity and acceleration analysis of simple mechanisms.
3. Design a layout of cam for specified motion.
4. Synthesis simple mechanisms for function, path generation and body guidance
5. Demonstrate an understanding of principle of gears

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F4100	**CO1**	**2**	**3**	**3**	**2**						**2**			**3**	**3**	**2**
	CO2	**2**	**2**	**2**	**2**						**1**			**2**	**2**	**2**
	CO3	**2**	**3**	**3**	**3**						**1**			**3**	**3**	**1**
	CO4	**3**	**2**	**2**	**2**						**2**			**3**	**2**	**2**
	CO5	**2**	**2**	**2**	**1**						**2**			**2**	**2**	**2**

Unit-1: **[14 hrs]**

Introduction: Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, linkage mechanisms, inversions of four bar chain, slider crank chain and double slider crank chain.

Velocity in Mechanisms: Velocity of point in mechanism, relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Rubbing velocity at a pin joint, Instantaneous center method, Types & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism

Unit-2: **[14 hrs]**

Acceleration in Mechanisms: Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, Klein's construction for Slider Crank mechanism and Four Bar mechanism, Analytical method for slider crank mechanism
Mechanisms with Lower Pairs: Pantograph, Exact straight line motion mechanisms- Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms–Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms.

Unit-3: **[14 hrs]**

Friction: Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction-uniform pressure and uniform wear, Belt and pulley drive, Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, centrifugal tension, condition for maximum power transmission, V belt drive

Brakes & Dynamometers: Shoe brake, Band brake, Band and Block brake, Absorption and transmission type Dynamometers

Unit-4: **[14 hrs]**

CAMS: Cams and Followers - Classification & terminology, Cam profile by graphical methods With knife edge and radial roller follower for uniform velocity, simple harmonic and parabolic motion of followers, Analytical methods of cam design – tangent cam with roller follower and circular cams with flat faced follower

Gears & Gear Trains: Classification & terminology, law of gearing, tooth forms & comparisons, Systems of gear teeth, 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, simple, compound, reverted and planetary gear trains, Sun and planet gear.

Text books:

1. Theory of Machines - Thomas Bevan
2. Theory of Machines and Mechanisms- Shigley
3. Theory of Machines – Khurmi & Gupta
4. Theory of Machines – R. K. Bansal

Reference books:

1. Theory of Machines and Mechanisms-Ghosh & Mallik
2. Theory of Machines and Mechanisms- Rao & Dukkipati
3. Theory of Machines-S.S. Rattan
4. Kinematics of Machines-Dr. Sadhu singh
5. Mechanics of Machines – V. Ramamurti
6. Theory of Machines – V. P. Singh
7. Theory of Machines – Malhotra & Gupta

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F4200	**ENGINEERING FLUID MECHANICS**	16	HC	3	1	0	4	5

Objectives: The aim of this course is

1. To give an introduction and explain basic fundamentals of fluid mechanics. Also to learn fluid properties and pressure measurements
2. To incorporate concepts of stability of floating and submerged bodies which are essential in the field of shipping industries. To gain the knowledge of kinematics and dynamics of the fluids.
3. To know the applications of bernoulli's equation like flow measuring devices,dimesional analysis and also the flow behaviour and losses in the pipes
4. The know the importance of Reynolds number, boundary layer theory and also to give an introduction to compressible and navier stokes equation

Expected Outcome: Student will be able to

1. Utilize the properties of fluid and pressure concepts for varoius practical purposes
2. Find the stability and comfort conditions of the marine vehicles. To use the concepts of Bernouli equation and continuity equation for the varoius engineering purposes
3. Find the dependent and independent parameters for a model of fluid flow, analyse the model and the prototype and also design the flow through pipes
4. Distinguish the laminar and turbulent flows, apply the knowledge of lift and drag forces in aerospace industries

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F4200	**CO1**	**3**	**2**	**2**	**1**									**3**	**2**	**2**
	CO2	**3**	**3**	**2**	**2**									**3**	**2**	**2**
	CO3	**3**	**3**	**2**	**1**									**2**	**2**	**2**
	CO4	**3**	**2**	**2**	**2**									**2**	**1**	**1**

Unit-1: **[14 hrs]**

Properties of Fluids: Introduction, types of fluid, properties of fluids, viscosity, compressibility, surface tension, capillarity.

Fluid Statistics: Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple and differential manometers. Total pressure and center of pressure on submerged plane (horizontal, vertical and inclined) surfaces, curved surface submerged in liquid.

Unit-2: **[14 hrs]**

Buoyancy, center of buoyancy, metacentre and metacentric height, equilibrium conditions of floating and submerged bodies, determination of Metacentric height experimentally and theoretically. Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function , simple problems.
Fluid Dynamics: Introduction equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation, Impulse momentum equation,simple problems

Unit-3: **[14 hrs]**

Fluid Flow Measurements**:** Venturimeter, orificemeter, pitot-tube, V-Notch and rectangular notches,Dimensional Analysis : Introduction, Rayleigh's method, Buckingham □□theorem, dimensionless numbers, similitude, types of similitudes.
Flow through pipes: Minor losses through pipes. Darey's and Chezy's equation for loss of head due to friction in pipes. HGL and TEL, simple numericals.

Unit-4: **[14 hrs]**

Laminar flow : Reyonold's number, critical Reynold's number, laminar flow through circular pipe-Hagen Poiseille's equation, laminar flow between parallel and stationary plates.
Flow past immersed bodies: Drag, Lift, expression for lift and drag, boundary layer theory, displacement, momentum and energy thickness. Introduction to Navier stokes equation (no derivation), Introduction to compressible flow: Mach number,

Text Books:

1. **Fluid Mechanics**, Dr. Bansal, R.K.Lakshmi Publications, 2004.
2. **Hydraulics and Fluid Mechanics Including Hydraulics Machines,** P.N Modi and S.N Seth**,**, 19 Edition Standard Publishers Distributors (2013)

Reference Books:

1. **Fluid Mechanics (SI Units),** Yunus A. Cengel John M.Oimbala, 2nd Ed., Tata McGraw Hill, 2006.
2. **Fluid Mechanics,** Oijush.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
3. **Fluid Mechanics and hydraulics,** Dr.Jagadishlal: Metropolitan Book Co-Ltd., 1997.

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F4300	**MANUFACTURING TECHNOLOGY – II**	16	HC	2	0	1	3	4

Objectives:

1. To study machine tools and basic machining processes.
2. To know the fundamentals of metal cutting and tool engineering.

3. To familiarize with modern machine tools.

Outcomes:
Learner should be able to ….
1. Understand chip forming processes such as turning, milling, drilling, etc.
2. Understand the design aspects of cutting Tools and Economics of machining.
3. Distinguish between the conventional and modern machine tools.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PS
BTME14F4200	**CO1**	**3**	**2**	**2**		**3**					**2**			**3**	**2**	**2**
	CO2	**2**	**2**	**2**		**2**					**2**			**2**	**2**	**2**
	CO3	**3**	**2**	**2**		**3**					**2**			**3**	**2**	**1**

Unit–1: Theory of Metal Cutting

Deformation of metal during machining, nomenclature of lathe tool, mechanics of chip formation, Types of Chips ,built-up edges, mechanics of orthogonal and oblique cutting, Merchant cutting force circle and shear angle relationship in orthogonal cutting, Ernst Merchant's solution, factors affecting tool forces, Cutting speed, feed and depth of cut, surface finish. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life, Tool Failure Criteria, Taylor's Tool Life equation. Problems on cutting forces and tool life evaluation. **(06 hrs)**

Cutting Tool Materials and Cutting fluids: Characteristics of tool materials, various types of cutting tool materials, coated tools, cutting tool selection, Purpose and types of cutting fluids, basic actions of cutting fluids, effect of cutting fluid on tool life, selections of cutting fluid. Heat generation in metal cutting, factors affecting heat generation, Heat distribution in tool and work piece and chip, Measurement of tool tip temperature. **(06 hrs)**

Unit–2: Turning (Lathe), Shaping and Planing Machines:

Introduction, Classification, constructional features of Turret and Capstan Lathe. Tool Layout, Shaping slotting and planing machines – Principles of working – Principal parts – specification, classification, Different operations on lathe, shaping machine and planing machine. Simple problems on machining time calculations **(06 hrs)**

Drilling and Boring Machines: Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Types of twist drill & drill bit nomenclature, drill materials, Calculations in drilling. Introduction to CNC machines - Principles of operation. Axes of NC machine-Coordinate systems. Basics of Manual part programming methods. **(06 hrs)**

Unit-3: Milling Machines:

Milling machine – Principles of working – specifications – classifications of milling machines – Principal features of horizontal, vertical and universal milling machines, Comparison between upmilling and Down milling, machining operations types, geometry of milling cutters – milling

cutters – methods of indexing Simple, compound, differential and angular indexing calculations. Simple problems on simple and compound indexing. **(06 hrs)**

Grinding Machines

Grinding machine – Fundamentals – Theory of grinding – classification and constructional teatures of grinding machine – cylindrical, Centreless and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines –Different types of abrasives Grain size, bonding process, grade and structure of grinding wheels, grinding wheel types and selection of a grinding wheel , Grinding process parameters. Dressing and truing of grinding wheels.

(06 hrs)

Unit-4: Lapping, honing and broaching machines

Lapping and honing operations – Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application

Broaching: Principle of broaching, Details of a broach. Types of broaching machines-constructional details. Applications, Advantages and Limitations. **(06 hrs)**

Non Traditional machining: Abrasive jet machining: Principles, applications, process parameters. Ultrasonic machining: Principles, applications, analysis of process parameters. Electro-chemical machining and grinding: Principles, classifications, choice of electrolytes, applications. Electric discharge machining: Principles, selection of tools materials and dielectric fluid. Electron beam machining: Generation of electron beam, relative merits and demerits. Laser beam machining: Principles and applications. (06 hrs)

Text Books:

1. **Workshop Technology,** Hazara Choudhry, Vol-II, Media Promoters & Publishers Pvt. Ltd. 2004
2. **Production Technology,** R.K.Jain, Khanna Publications, 2003.
3. **Production Technology,** HMT, Tata Mc Graw Hill, 2001.

Reference Books:

1. Manufacturing Science, Amitabha Ghosh and Mallik, affiliated East West Press, 2003.
2. Fundamentals of Metal Machining and Machine Tools**,** G.Boothroyd, McGraw Hill, 2000.
3. Principles of Machine Tools – G.C. Sen & A. Bhattacharya, Tata McGraw Hill, New Delhi
4. Manufacturing Engg. & Tech, Kalpakian, Serope Addison -Wisly Publishing Co. New York.
5. Modern Machining Processes: P.C. Pandey & H.S. Shan, T.M.H. Company, New Delhi
6. Text Book of Production Engineering: P.C. Sharma, S.Chand & Sons
7. Manufacturing Technology – Metal cutting and machine Tools: P.N. Rao, T.M.H, New Delhi

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F4400	**MECHANICAL MEASUREMENTS AND INSTRUMENTATION**	16	HC	2	1	0	3	3

Objectives:

1. Impart the knowledge of standards importance and conversion.
2. Define the fundamental concepts and derive the relations for the design of gauges, types of

Gauges, concepts involving comparators, angular measurements, screw thread and gear Measurements.
3. Define the fundamental methods of measurement, concept of transducer and intermediate Modifying devices and terminating devices.
4. Clear exposure to the errors, classification and remedies.
5. To explore the students to various aspects regarding the force, torque, strain, pressure and Temperature measurements.
6. To identify, analyze the concept and the principle advantages and applications of the above Measurements.

Subject learning outcomes

1. Students learn and understand the need, history for the development of new concepts with Metrology and measurement.
2. Students will demonstrate the knowledge of standards, comparison between the standards And their conclusion.
3. Will have learnt the capability to recognize the need for measurement, the fundamental Concepts of measurement, conduct the experiments and record the data and interprete the Results.
4. Will have acquired the ability to recognize the concept of errors and accuracy.
5. Will have the capability to apply the skills in measuring force, torque, strain, pressure and Temperature.
6. Will have acquired the ability to recognize the global, societal and ethical aspects of the Work with social and ethical responsibilities as related to metrology and measurement.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME14F4400	CO1	2	3		2	2		3			2			3	2	3
	CO2	2	2		2	2		2			2			2	2	2
	CO3	2	3		2	2		2			2			3	3	2
	CO4	2	2		2	3		2			1			2	3	2
	CO5	1	3		3	2		3			2			2	2	3
	CO6	1	1		1	2		2			2			2	2	2

Unit-1: Standards of measurement:
Introduction, Definition and Objectives of metrology, Role of standards, Standards of length-International prototype meter, Imperial standard yard, Light wave length standard, subdivision of standards, line and end standard, comparison, transfer from line standard to end standard, calibration of end bars (Numerical), Slipgauges, Wringing phenomena, Indian Standards (M-45,M-87, M-112), Numerical problems on building of slip gauges. **(06 hrs)**

Limits,Fits ,Tolerance and Gauging
Introduction, Need of limit systems, Definition of Limit and tolerance, Specification in assembly, interchangeability and selective assembly ,limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919-1963), geometrical tolerance, positional-tolerances, system of fits, Tolerance grade, Numerical problems, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials. Numerical problems **(06 hrs)**

Unit-2: Comparators and Angular measurement:

Introduction to comparators, Need for a comparator, characteristics, classification of comparators, mechanical comparators- Johnson Mikrokator, sigma comparators, dial indicator, optical comparator: Principle of optical lever, Mechanical-optical comparator, Zeiss ultra optimeter, Advantages and Disadvantages, electrical and electronic comparators: principles, LVDT, Advantages and Disadvantages, pneumatic comparators, back pressure gauges, solex comparator, Angular measurements, Vernier bevel protractor, principle ,use and limitation of sine bar , sine centre, use of angle gauges (numericals on building of angles). **(06 hrs)**

Interferometer,screw thread and gear measurement:
Principle of interferometry, Interference pattern, optical flat, autocollimeter, Screw thread: Introduction, Terminology, types and errors. Measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, Expression for best size wire. Tool maker's microscope, gear tooth terminology, use of gear tooth vernier caliper and micrometer.
(06 hrs)

Unit-3: Measurements and measurement systems:
Introduction, Definition, Requirement of measurements, significance of measurement system, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysterisis, repeatability, linearity, loading effect, system response-times delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers. **(06 hrs)**

Intermediate modifying and terminating devices:
Introduction, Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers, Vacuum tube amplifiers and telemetry. Introduction to Terminating devices, Meter indicators, CRO, Measurement of frequency, oscillographs, X-Y plotters.
(06 hrs)

Unit-4: Measurement of force, torque and pressure:
Introduction, Direct method: Analytical balance, unequal arm balance, Platform balance, proving ring. Torque measurement: Mechanical, hydraulic dynamometer, Pressure measurements, principle, use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge. **(06 hrs)**

Temperature and strain measurement: Introduction, Resistance thermometers, thermocouple, law of thermo couple, Thermocouple materials and construction, Measurement of thermal emf, pyrometer, optical pyrometer. Strain measurements, strain gauge, preparation and mounting of strain gauges, gauge factor, Theory of strain gauges, methods of strain measurement. **(06 hrs)**

Text Books:

1. **Mechanical Measurements,** Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. **Engineering Metrology,** R.K. Jain, Khanna Publishers, 1994.

Reference Books:

1. **Engineering Metrology,** I.C. Gupta, Dhanpat Rai Publications, Delhi.
2. **Mechanical Measurements,** R.K. Jain Khanna Publishers, 1994.
3. **Industrial Instrumentation,** Alsutko, Jerry. D. Faulk, Cengage Asia Pvt. Ltd. 2002.
4. **Measurement Systems Applications and Design,** Ernest O. Doebelin, 5th Ed., McGraw Hill Book Co.
5. **Metrology & Measurement,** Anand K. Bewoor & Vinay A. Kulkarni, Tata McGraw.

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.

BTME14F4500	**APPLIED THERMODYNAMICS**	16	HC	3	1	0	4	5

Preamble

Applied Thermodynamics is the study of application of concepts of Basic Thermodynamics. Applied Thermodynamics is relevant to the study of thermodynamic processes involving energy conversion including chemical reactions and the processes that occur in real time applications such as engines, compressors, turbines or rocket engines, refrigeration systems, etc. At present the world is depends on fossil fuels which are depleting nature and responsible for global warming. Hence there is a demand for clean fuel and new technology to solve the problems in energy field. Applied thermodynamics deals with power cycles, combustion chemistry, refrigeration and air-conditioning. It also deals with devices applicable to aerospace application. Aerospace engineering is one of the emerging fields at present scenario. By studying this subject the student can gain the knowledge and may find solution for the present problems.

Subject learning objectives:

1. To understand and apply concepts of thermodynamics to various energy conversion processes and systems.
2. To understand the chemical reactions involved in combustion process and energy released during the combustion.
3. To study the various aspects of IC engines, testing of engines and performance evaluation.
4. To study various thermodynamic cycles which are the basics for development of the various devices used in aerospace, power generation, nuclear sector etc,.
5. To understand the properties of air, working of air conditioner gives idea about designing the equipments for comfortless.
6. To prepare students to apply various concepts in thermodynamics to solve numerical and Design problems of various thermodynamic processes and systems and provide useful solution.
7. To train students about engines, working of engines, testing of engines by conducting experiments, making measurement of test parameters and analysis the test data.
8. To make students aware of the current advancements in various aspects of thermodynamics such as automobile engines, power generation systems etc,.

Course outcomes:

1. Students can able to analyze the thermodynamic process/cycles involved in engineering applications.
2. Able to find power, efficiency and losses in thermodynamic system or devices during execution of process.
3. Analysis of various systems under different circumstances in thermodynamic point of view.
4. Able to find performance of engineering devices like IC engine, turbines, compressors, refrigerator and air-conditioner.
5. Behavior of working fluid in various thermodynamic systems.
6. Capability to apply various concepts in thermodynamics to solve numerical and design problems of various thermodynamic processes and systems and provide useful solution.
7. R and D work involving automobile, energy and aeronautical applications.
8. This subject is prerequisite for future semester subjects like Turbomachinary, heat transfer; hence he/she can study those subjects without difficulty.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO	PO	PO	PSO1	PSO2	PSO3

	COs										**10**	**11**	**12**			
BTME14F4500	**CO1**	**3**	**2**	**3**	**2**			**2**				**2**		**3**	**2**	**2**
	CO2	**2**	**3**	**3**	**2**			**3**				**2**		**2**	**2**	**2**
	CO3	**2**	**3**	**3**	**3**			**3**				**2**		**3**	**2**	**2**
	CO4	**3**	**2**	**2**	**3**			**2**				**2**		**3**	**2**	**3**
	CO5	**3**	**2**	**2**	**2**			**2**				**3**		**2**	**2**	**2**
	CO6	**2**	**2**	**1**	**2**			**2**				**2**		**2**	**1**	**2**
	CO7	**2**	**1**	**1**	**1**			-				--		-	**1**	**1**
	CO8	**2**	**1**	**1**	**1**			-				-		-	**1**	**1**

Unit-1:

I.C.Engines: Brief description about IC engines and its parts, Combustion in SI and CI engines, Detonation or knocking and its effect, Delay period in CI engines, diesel knock and methods of controlling the diesel knock, Octane number, Cetane number, Theoretical (Stoichiometric) air for combustion of fuels, excess air, actual combustion. Exhaust gas analysis. A/F ratio, energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, combustion efficiency.

6 Hrs.

Testing of IC Engines: Basic definitions of Brake power, Indicated power, Thermal efficiencies etc. Testing of two-stroke and four-stroke Sl and CI engines for performance, measurement of BP, IP & FP Various methods, Morse test, heat balance sheet and related numerical problems.

6 Hrs.

Unit-2: Air Standard cycles:

Air standard cycles, Carnot, Otto, Diesel, Dual and Stirling cycles, p-v and T-s diagrams, description, efficiencies and mean effective pressures. Comparison of Carnot's, Otto, diesel and Dual cycles. Problems for finding efficiency and mean effective pressures.

6Hrs.

Gas turbines and Jet propulsion: Gas turbine (Brayton) cycle; description and analysis of open cycle gas turbine. Derivations of equations for work ratio and Pressure ratio for maximum power output. Considering machine effencies, numerical problems. Methods of improve thermal efficiency (no numerical on this topic). Jet propulsion and Rocket propulsion. **6 Hrs**.

Unit-3: Vapour Power Cycles:

Carnot vapour power cycle, limitations. Simple Rankine cycle; description, T –s diagram, analysis for performance. Comparison of Carnot and Rankine cycle. Effects of pressure and temperature on Rankine cycle performance. Ideal and practical regenerative Rankine cycles, open and closed feed water heaters. Reheat Rankine cycle. (Simple numerical on regenerative and reheat cycles)

6 Hrs.

Reciprocating Compressors

Working of a single stage reciprocating compressors. Work input through p-v diagram without clearance and with clearance. Effect of clearance volume. Volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multi-stage compression, advantages, saving in work. Condition for minimum work, inter-cooling, minimum work for compression. **6 Hrs.**

Unit-4: Refrigeration:

Introduction, units of refrigeration, COP. Vapour compression refrigeration system; description, analysis, refrigerating effect, capacity, power required, Refrigerants and their desirable properties, commonly used refrigerants. Vapour absorption refrigeration system (no numerical on this topic). Air cycle refrigeration; reversed Carnot cycle, reversed Brayton cycle. **6 Hrs.**

Psychrometry and air-conditioning: concept of psychrometry and psychrometric properties; Dry bulb temperature, wet bulb temperature, dew point temperature; partial pressures, specific and relative

humidifies and adiabatic saturation temperature. Use of psychometric chart. Analysis of various psychrometric processes; heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream of moist air. Summer and winter air – conditioning. **6 Hrs.**

Text Books:

1	P.K. Nag	Basic & Applied Thermodynamics. Tata McGraw Hill.2002.
2	Yunus A. Cenegal and Michael A.Boles	Thermodynamics-An Engineering Approach. Tata McGraw Hill. 2002.

Reference Books:

1	Rajput R.K.	Thermal Engineering. Lakshmi publications.
2	Mahesh M Rathore	Thermal Engineering. Tata McGraw-Hill. Prentice-hall of India Pvt. Ltd.
3	Thermodynamics Data Hand book	B T Nijaguna & Samaga

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F4600	**PRINCIPLES OF MANAGEMENT**	16	HC	3	1	0	4	5

Course Learning Objective

1. The course is to provide the students, with an opportunity to gain the knowledge in the field of management by its history, evolution, functions and theories.
2. To learn the effective methods of better utilization of resources (men, machine, material and money) for the successful enterprise.
3. The aim of the course is to provide the students, with an opportunity to gain the knowledge in the field of entrepreneur, entrepreneurship and management of resources.
4. The student learns the function, types, role of entrepreneur in economic growth of a country. And also studies the different stages of entrepreneurial process.
5. The course is to provide the students, with an opportunity to gain the knowledge to start up small scale industries with the support (consultancy & finance) from government, institutes & others.
6. To learn the effect of WTO/GATT and government policies (industrial policy regulations) on small scale industries for their development.
7. To learn the project identification, project selection & project formation by following guide lines of planning commission.
8. To learn the methods of analysis of the project (interns of market, technical, financial & social feasibility study) and put it in the report form

Course learning outcome

1. Students should understand the necessity of management in the field of engineering
2. Students should realize the importance of entrepreneurship in the modern world
3. Students should understand the definition, characteristics and role of SSI in economic development. Impact of privatization and globalization on SSIs.
4. Students should understand the meaning of project and project identification.
5. They should analyse the parameters of project like project appraisal, identification of business opportunities, market feasibility study, technical feasibility study etc.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	**PO 5**	PO 6	P 7	PO 8	**PO 9**	**PO 10**	**PO 11**	PO 12	PSO 1	PSO 2	PSO 3
BTME14F4600	**CO 1**					**3**			**3**	**3**	**3**	**3**		**3**	**2**	**2**
	CO 2					**3**			**2**	**3**	**3**	**3**		**3**	**2**	**1**
	CO 3					**3**			**3**	**3**	**3**	**2**		**3**	**2**	**1**
	CO 4					**2**			**3**	**2**	**2**	**2**		**3**	**2**	**2**
	CO 5					**2**			**2**	**2**	**3**	**3**		**2**	**3**	**1**

Unit-1:

Management- Introduction, Meaning, nature and characteristics of management. Scope & functional areas of management. Management as a science, art or profession. Management and Administration, Role of management, Levels of management, early management approaches, and Modern management approaches **8hrs**

Planning-Nature, Importance and purpose of planning process, Objectives, types of plans (meaning only) Steps in planning, Planning premises, Hierarchy of plans **4hrs**

Unit-2:

Organizing and Staffing-Nature and purpose of organization, Principles of organization, Types of organization – Departmentation, Committees – centralization V/s decentralization of authority and responsibility, Span of control- MBO and MBE, Nature and importance of staffing, Process of selection and recruitment **6hrs**

Directing & Controlling-Meaning and nature of directing, leadership styles, Motivation theories, Communication- meaning and importance, Co-ordination, meaning and importance, techniques of coordination, Meaning and steps in controlling, Essentials of a sound control system, methods of establishing control. **6hrs**

Unit-3:

Entrepreneurship-Meaning of entrepreneur, evaluation of the concept, function of an entrepreneur, types of entrepreneur, entrepreneurship, concept of entrepreneurship, evolution of entrepreneurship, development of entrepreneurship, Stages in entrepreneurial process, Role of entrepreneurs in economic

development entrepreneurship in India, Entrepreneurship - its barriers, limitations of entrepreneurs. **6hrs**

Small Scale Industry: Definition, characteristics, types, role of SSI in economic development. Steps to start an SSI – Govt. policy towards SSI, different policies of SSI, Govt. support for SSI, Impact of liberalization, privatization, globalization on SSI, Effect of WTO/ GATT, supporting agencies of Govt. for SSI, Ancillary industry and tiny industry (Definitions and objectives only) **6hrs**

Unit-4:

Institutional Support-Different Schemes, TECKSOK, KIADB, KSSIDC, KSIMC, DIC, Single window Agency, SISI, NSIC, SIDBI, KSFC. **5hrs**

Preparations for a Project-Meaning of Project; Project Identification Project Selection, Project Report, Need and significance of Report, contents, Formulation Guidelines by Planning Commission for Project report, Network Analysis; Errors of Project Report, Project Appraisal, Identification of Business Opportunities, market Feasibility Study, Technical Feasibility study, Financial Feasibility Study & Social Feasibility study. **7hrs**

Text Books:

1. Principles of Management, PC Tripati, P N Reddy,–Tata Mc Graw Hill, 3rd edition 2005.
2. Dynamics of Entrepreneurial Development & Management, Vasant Desai Himalaya Publishing House, 2nd edition 2006
3. Entrepreneurship Development–small Business Enterprises Poornima M Charanthmath, Pearson Education –3rd edition 2005

Reference Books:

1. Management Fundamentals, Robert Lusier–Concepts, Application, Skill Developmenthomson, 1st edition. 2006
2. Entrepreneurship Development, S S Khanka S Chand & Co, 4th edition2005 Management, Stephon Robbins Pearson Education/PHI 17th Edition 2003.
3. Principles of Management by Koontz and O'Donnell, TMH
4. Management – Stephen Robbins – Pearson Education/PHI – 17th

Course Code	Course Title	Duration (Weeks	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F4700	**MACHINE SHOP**	16	HC	1	0	1	2	4

Objectives:

1. To understand various operations to be carried out through various machines.
2. To provide knowledge about various machine tools.
3. To gain knowledge of operations that can be performed in turning and milling machines.
4. To learn the operations that can be performed in shaping machines.

Outcomes:

Learner should be able to ……

1. Identify the various operations required to prepare the model.
2. Select the suitable machine for a particular operation.
3. Prepare the specimen as per the given dimension for the given raw material.
4. Demonstrate the various operations that can be carried out in turning, milling and shaping machines.
5. Prepare the document based on the experiment/test conducted.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME14F4700	CO1	2	2			3		2			2			3	2	2
	CO2	2	2			2		2			3			3	3	2
	CO3	2	3			2		2			3			3	2	2
	CO4	2	2			3		2			3			3	1	1
	CO5	-	-			-		-			-			-	-	-

PART – A

Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.

PART – B

Cutting of V Groove/ Rectangular groove using a shaper

Cutting of Gear Teeth using Milling Machine

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./ Wk.
BTME14F4800	**Measurement and Instrumentation Lab**	16	HC	1	0	1	2	4

Objectives:

1. To explore the use of strain gauges in load cell and in the determination of youngs modulus.
2. To impart the knowledge about the pressure and temperature measuring devices.
3. To understand the measurement of cutting forces during turning and drilling operations
4. To gain knowledge about the measurement of effective diameter, taper angle and surface roughness.

Outcomes:

Learner should be able to ……

1. To describe the application of strain gauges in load and strain measurement.
2. To explain the principle of pressure and temperature measurement.
3. To compute the power required and resultant forces during turning operation.
4. Demonstrate the measurement of drilling forces, thread parameters, gear parameters and angles of the component.
5. Prepare the document based on the experiment/test conducted

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME14F4800	CO1	2	3		2	2					2			3	2	2
	CO2	2	2		2	2					2			3	2	2
	CO3	2	3		1	2					2			2	3	2
	CO4	1	2		2	2					1			2	2	2
	CO5	-	-		-	-					-			-	-	-

PART-A: MECHANICAL MEASUREMENTS

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

PART-B: METROLOGY

1. Measurements using Optical Projector / Toolmaker Microscope.
2. Measurement of angle using Sine Center / Sine bar / bevel protractor
3. Measurement of alignment using Autocollimator / Roller set
4. Measurement of cutting tool forces using

a) Lathe tool Dynamometer
b) Drill tool Dynamometer.

5. Measurement of Screw thread Parameters using Two wire or Three-wire method.
6. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
7. Measurement of gear tooth profile using gear tooth vernier /Gear tooth micrometer
8. Calibration of Micrometer using slip gauges
9. Measurement using

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F5100	**Turbo machinery**	16	HC	3	1	0	4	5

Prerequisite: Fluid Mechanics , Engineering Thermodynamics.

Course Objectives:

1. To provide a sound understanding of the comparison of positive displacement machine and Turbo machine.
2. To provide knowledge about impact of jet on vanes.
3. To provide an understanding of energy transfer in turbo machinery.
4. To provide knowledge about general analysis of radial flow turbo machines.
5. To provide knowledge about general analysis of axial flow turbo machines.
6. To provide knowledge of design of hydraulic turbines and its characteristics.
7. To provide knowledge about design of centrifugal pumps
8. To provide knowledge of flow through nozzles.
9. To provide knowledge of design of steam turbines.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Sound understanding of positive displacement machines and turbo machines.
2. Sound understanding of Euler turbine equation and velocity triangles.
3. Knowledge of velocity triangles of axial flow turbines and compressors.
4. Understanding of hydraulic turbines and centrifugal pumps.
5. Understanding of steam turbines.

6. Understanding of performance test on various types of hydraulic turbines and pumps.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15F5100	CO1	2	2	3	-	-	-	-	-	-	-	-	-	3	3	3
	CO2	2	3	3	1	-	-	-	-	-	-	-	-	3	3	3
	CO3	3	3	3	3	1	-	-	-	-	-	-	-	3	3	3
	CO4	2	2	3	-	-	-	-	-	-	-	-	-	3	3	3
	CO5	3	2	3	-	-	-	-	-	-	-	-	-	2	2	2

Unit-1: **12 hours**

Introduction: 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. Illustrative examples.

Impact of jets: Introduction, Force exerted by the jet on a stationary vertical plate, symmetrical and unsymmetrical curved vane at centre and tangentially at one of the tip. Force exerted by the jet on a moving vertical plate, force exerted by jet of water on unsymmetrical moving curved vane when jet strikes at centre and tangentially at one of the tips. Force exerted by a jet of water on series of plate (condition for maximum efficiency). Illustrative examples.

Unit-2: Energy Transfer in Turbo Machine: **16 hours**

Euler Turbine equation; Alternate form of Euler turbine equation – components of energy transfer; Degree of reaction, Utilization factor, Vane efficiency; Relation between utilization factor and degree of reaction; Velocity triangles for different values of degree of reaction for axial flow turbines, Velocity triangles and condition for maximum utilization factor – optimum blade speed ratio for different types of turbine. Comparison of Energy transfer, Illustrative examples.

General analysis of Power absorbing turbo machines– General analysis of axial flow Compressors and pumps , velocity triangles and general expression for degree of reaction, 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. Illustrative examples.

Unit-3: Hydraulic Turbines: **12 hours**

Classification; Different efficiencies; Pelton Turbine-velocity triangles, condition for maximum efficiency, Design parameters; Francis turbine-velocity triangles, Design parameters; Function of a Draft tube, types of draft tubes; Kaplan and Propeller turbines – Velocity triangles and Design parameters. Illustrative examples.

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel, Illustrative examples.

Unit-4: **16 hours**

Steam Nozzles: Type of Nozzles- Flow Through Nozzles- Condition for Maximum Discharge-Nozzle Efficiency- Super Saturated Flow in Nozzles- Relationship Between Area Velocity and Pressure in Nozzle Flow. Illustrative examples.

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Reaction turbine – Parsons's turbine, condition for maximum utilization factor. Illustrative examples.

Text Books:

1. An Introduction to Energy Conversion, Volume III, Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008.

2. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw Hill Co. Ltd., 2nd edition, 2002

Reference Books:

1. Principals of Turbomachines, D. G. Shepherd, The Macmillan Company (1964).
2. Fluid Mechanics & Thermodynamics of Turbomachines, S. L. Dixon, Elsevier (2005).
3. Turbomachine, B.K.Venkanna PHI, New Delhi 2009.
4. Text Book of Turbomachines, M. S. Govindgouda and A. M. Nagaraj, M. M. Publications, 4Th Ed, 2008.
5. Thermal Engineering, by R.K.Rajput., Laxmi Publications

MACHINE DESIGN – I

Subject Code	BTME15F5200	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-2-0=5	Exam Marks	50

Pre requisites: Knowledge of mechanics, Material science, and Strength of materials

Preamble

For the manufacture of any machine component the first and foremost operation is design. The design concept involves identifying the problem, selection of process material, environmental conditions and proper understanding of various types of loads and its effect for the maximum production of any machine component.

This course machine design deals starting with the concepts of basic design of machine components taking all the factors mentioned above into account.

Course Objectives:

1. To introduce the students to the fundamental concepts of the mechanical design and to various codes and standards related to engineering materials.
2. To make the students to learn about the usage of Design Data Hand book.
3. To carry out the design of various machine members subjected to static, impact and fatigue loads.
4. To understand the importance of design of shaft subjected to torsion, bending etc.,
5. To get acquainted with the design process of various machine members like keys, joints, couplings, riveted and welded joints, threaded fasteners, power screws.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Better understanding of fundamental concepts related to the mechanical design.
2. Knowledge about the design of various machine elements subjected to static, impact and fatigue loads.
3. Detailed procedure of the design process of machine members like keys, joints, couplings, riveted and welded joints, threaded fasteners, power screws.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F5200	CO1	2	3	1	-	-	-	-	-	-	-	-	-	2	2	2
	CO2	3	3	2	1	1	1	-	-	-	-	-	-	2	2	2
	CO3	3	3	3	-	-	1	-	-	-	-	-	-	2	2	2

Unit: 1 **12 hours**

Introduction: Types of mechanical engineering designs, Design Cycle, Engineering Materials and their mechanical properties, Selection of suitable materials for design, Design considerations, Codes and Standards (BIS designation of materials), Meaning of normal, shear, biaxial and tri axial stresses, Principal Stresses.

Design against Static & Impact Strength: Factor of safety, Theories of failure-Numerical, Stress concentration-Determination of Stress Concentration factor. Impact Strength- Introduction, Impact stresses due to axial, bending and torsional loads- Numerical.

Unit: 2 **12 hours**

Design against Fatigue Strength: Introduction, S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Modifying factors: size effect, surface effect, effect of notch sensitivity, Design based on Soderberg's and Goodman's relationship, fatigue design under combined loading,- Numericals.

Design of Shafts: Torsion of shafts, design for strength and rigidity with steady loading, ASME codes for power transmission shafting, shafts under combined loads (Bending & Tensional), Simple Numericals.

Unit: 3: **16 hours**

Threaded Fasteners: Stresses in threaded fasteners, Effect of initial tension,Design of threaded fasteners subjected to static loads, Design of eccentrically loaded bolted joints.

Cotter and Knuckle Joints, Keys and Couplings: Design of Cotter and Knuckle joints, Keys: Types of keys, Design of keys,

Couplings: Rigid and flexible couplings, Flange coupling, Bush and Pin type coupling and Oldham's coupling.

Unit: 4 **14 hours**

Riveted and Welded Joints – Types, rivet materials, failures of riveted joints, Joint Efficiency, Boiler Joints, Lozanze Joints, Riveted Brackets. Welded Joints – Types, Strength of butt and fillet welds, eccentrically loaded welded joints.

Power Screws: Mechanics of power screw, Stresses in power screws, efficiency and self-locking, Design of Power Screw, Design of major parts of Screw Jack.

Text Books:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Machine Design, R.S. Khurmi & J.K.Gupta, S. Chand Publications.

Reference Books:

1. Machine Design, Dr.P.C.Sharma & Dr.D.K.Agarwal,S.K.Kataria and Sons, New Delhi.
2. Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2009.

Design Data Handbook:

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher, 2010.

HYDRAULICS & PNEUMATICS

Subject Code	BTME15F5300	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=4	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisite: Fluid Mechanics

Preamble

History of fluid power goes back to our ancient civilization wherein man used water to generate power using water wheels, and air to run windmills and propel ships. These fluids were used in large quantities at relatively low pressure (corresponding to atmospheric pressure). Until industrial revolution in 1850 in England fluid power concept was not introduced in industries. But by 1870 fluid power was used in hydraulic cranes, jacks, shearing and riveting machines, water pumps etc. During and after World War II,

fluid power technology gained momentum. And today there is an after list of fluid power application in almost every industry. Automobiles, missiles, machine tools, aero planes etc. extensively use fluid power technology. This course deals with the fundamental aspects of hydraulics and pneumatics, the two fields of relevance to fluid power engineering.

Course Objectives:

1. To provide a sound understanding of the working of hydraulic and pneumatic systems.
2. To provide an understanding of energy transfer in hydraulic actuators and motors
3. To provide knowledge about controlling components of hydraulic and pneumatic systems.
4. To provide knowledge of design of hydraulic and pneumatic systems and analyze them. 5. To introduce the concept of signal processing elements and control.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Get knowledge about working of hydraulic and pneumatic systems.
2. Become aware about controlling components of hydraulic and pneumatic systems.
3. Have good understanding in selection, preparation and distribution of compressed air.
4. Be capable to compile the design of hydraulic and pneumatic systems and analyze them.
5. Demonstrate the need of pressure and time dependent controls.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F5300	CO1	2	2	2	2	-	-	-	-	-	-	-	1	3	3	2
	CO2	2	2	2	2	-	-	-	-	-	-	-	1	3	3	2
	CO3	3	3	3	3	-	-	-	-	-	-	-	1	3	3	2
	CO4	3	3	3	3	-	-	-	-	-	-	-	1	3	3	2
	CO5	2	2	2	2	-	-	-	-	-	-	-	1	3	3	2

Unit-1 **12 hours**

Fluid Power Systems and Fundamentals: Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics-Applications of Pascal's Law, Structure of Hydraulic System.

Unit-2 **12 hours**

Hydraulic System & Components: Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, Piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting

Unit-3 **12 hours**

Pneumatic Systems and Components: Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumatic and Hydraulic circuit

Unit-4 **12 hours.**

Design of Pneumatic Circuits : Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

Text Books:

1. Anthony Esposito, Fluid Power with Applications, Pearson Education 2000.
2. Majumdar S.R., Oil Hydraulics, Tata McGraw-Hill, New Delhi 2009.

References:

1. Majumdar S.R., Pneumatic systems – Principles and maintenance, Tata McGraw Hill, New Delhi 2005.
2. Anthony Lal, Oil hydraulics in the service of industry, Allied publishers, 1982.

THEORY OF MACHINES-II

Subject Code	BTME15F5400	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-2-0=5	Exam Marks	50

Pre requisites: Knowledge of Engg. Mathematics, Eng. mechanics, Strength of materials,

Preamble

The subject comprises a wider and deeper on the engineering aspects involving forces, inertia, friction and balancing of masses.

It covers bigger spectrum for dynamic aspects of machines that is, force analysis related to static equilibrium of two or three force members. It also covers four bar mechanisms and slider crank mechanisms with or without friction. Discussion involves the utilization of mechanical energy from I.C engines by using the flywheel.

It is aimed to study the different types of power transmission by using flat belt drives of open and cross belt with problems. The subject involves the study of rotating masses, so as balance the system by using the counter balancing masses in the same or different planes graphically or analytically.

Balancing of reciprocating masses is one of the important chapter, contains the effect of inertia of crank and connecting rod, related to single and multi cylinders with examples.

Subject also focuses on functions of governors and gyroscope, considering different types and their applications. For example applications of gyroscope to four wheeler, boat, aeroplane, etc.
In case of cam analysis, discussion involves in various types followers and motions.

Course Objectives:

1. To understand the synthesis and analysis of common mechanisms and concepts of turning moment diagrams, flywheel design
2. To understand the dynamics of engines, balancing of rotating and reciprocating masses, rotors and engines.
3. To study and realizations of speed control devices and their characteristics
4. To understand the working of mechanisms based on friction and its application
5. To develop the techniques of complete anatomy of all machineries

Course Outcomes:

After successful completion of the course, the students will be able to

1. Perform dynamic analysis of mechanisms like slider crank mechanism, four bar mechanism, IC engine and steam engine.
2. Do balancing of masses in rotation as well as reciprocating masses, rotors and engines.
3. Analyze and design of different types of governors and calculate gyroscopic couple.
4. Calculate frictional torque in different bearings, brakes and dynamometers and analyze belt drives.
5. Formulate the dynamic analysis of various machines like IC engine, steam engine, governors, gyroscopes, rotating masses, dynamometers.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F5400	CO1	3	2	2	2	-	1	-	-	-	-	-	-	2	2	1
	CO2	3	3	3	2	1	1	-	-	-	-	-	-	1	1	1
	CO3	3	3	2	1	-	1	-	-	-	-	-	-	2	2	2
	CO4	3	3	2	2	1	1	-	-	-	-	-	-	2	2	1
	CO5	2	2	2	2	-	1	-	-	-	-	-	-	2	2	2

Unit-1 **12 hours**

Static & Dynamic Force Analysis : Static equilibrium of two/three force members, Static equilibrium of member with two forces and torque, Static force analysis of linkages, D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Engine force analysis- Piston and crank effort

Turning Moment & Flywheel: Turning moment on crankshaft, Turning moment diagrams-single cylinder double acting steam engine, four stroke IC engine and multi-cylinder steam engine, Fluctuation of energy, Design of Flywheel.

Unit-2: **14 hours**

Balancing of Machines: Balancing of rotating masses: Static and dynamic balancing, Balancing of several masses in the same plane and different planes,

Balancing of reciprocating masses: Balancing of primary force in reciprocating engine, Partial balancing of two cylinder locomotives, inline and V-engine, Swaying couple, hammer blow. Numericals

Unit-3: **14 hours**

Governors: Introduction, Principles, Types of governors, Terminology, Porter & Hartnell governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor, controlling force diagrams. Numericals.

Unit-4: **12 hours**

Gyroscopic Motion: Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes, ship & automobiles (two & four wheelers).

Text books:

1. Theory of Machines - Thomas Bevan,3rd edition,CBS publications.
2. Theory of Machines and Mechanisms- Shigley, 3rd edition Mc Graw Hill Book company
3. Theory of Machines – R S Khurmi & J K Gupta, 5th edition, S. Chand publications
4. Theory of Machines – R. K. Bansal , 6th edition, Laxmi Publications

Reference books:

1. Theory of Machines and Mechanisms-Ghosh & Mallik 3rdedition, East westpress
2. Theory of Machines-S.S. Rattan, 3rd edition, 2013,TMH publications
3. Kinematics of Machines-Dr. Sadhu singh, 2nd edition,Pearson Publication

Sub Code: BTME15F5500	**Numerical Methods for Mech. Engg**	L	T	P	C	Contact Hours
Duration: 13 Weeks		3	0	0	0	3

Prerequisites: Mathmatics-1, 2, 3

Course Objectives:

To study and understand the application approach of the concepts of Numerical methods, Laplace transform, Calculus of variations in various fields of engineering.

Course Outcomes:

After successful completion of the course, the students will be able to

1. To understand the basics of numerical methods and their applications.
2. To solve the problems of differential equation using Laplace transform in various engineering fields.
3. To apply the Calculus of variations concepts to solve various engineering problems.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F550 0	CO1	3	2	1										2	2	2
	CO2	3	1	2										3	2	2
	CO3	3	2	2										2	2	2

Unit –I (13 hours)

Numerical Methods –III: (i) Numerical solution of simultaneous first order ODE: Picard's and Runge-Kutta method of fourth order.

(ii) Numerical solution of second order ordinary differential equations, Picards method, Runge-Kutta method and Milne's method

(iii)Numerical solutions of PDE: Finite difference approximations to derivatives, Numerical solution of two –dimensional Laplace equation, one-dimensional Heat and Wave Equations.

Unit-II (13 hours)

Optimization: Introduction, origin, scope, limitation, approach, linear programming, mathematical formulation of LPP, Graphical Method, Simplex method, Big M-method.

Unit-3 (13 hours)

Calculus of variations : Introduction , functional, Euler's Equation and its solution, geodesics , Isoperimetric problems , several dependent variables, functionals involving higher order derivatives, approximate solution of Boundary value problems –Rayleigh-Ritz method, Weighted residual method – Galerkin's method , Hamilton's principles, Lagrange's equations.

UNIT-4: (13 hours)

Laplace Transform:Definition, Transforms of elementary functions, properties of Laplace Transforms(without proof) problems. Transforms of periodic functions (only statement and problems), Unit step functions and unit impulse functions.

Inverse Laplace transforms- Problems, convolution theorem (without proof)- verification and problems, solution of linear differential equation using Laplace transforms.

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 10th edition, 2015.

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2014.

INTERNAL COMBUSTION ENGINE

Subject Code	BTME15F5610	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisite: Applied Thermodynamics

Course Objectives:

1 To introduce students to the working of spark ignition and compression ignition engines.
2. To teach students about the usage of alternate fuels for IC engines.
3. To enhance the understanding of students in engine emissions, pollution and their control.
4. To introduce students to the recent trends in IC Engines like stratification, multi point injection, plasma ignition etc.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Determine performance and combustion characteristics of SI and CI engines.
2. Identify the usage of alternate fuels and power plants for automobiles.
3. Determine emissions from SI and CI engines.
4. Demonstrate the ability to enhance the efficiency and performance of IC engines.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F561 0	CO1	3	3	1	-	-	-	-	-	-	-	-	-	3	2	2
	CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	3	1
	CO3	2	1	-	-	1	-	-	-	-	-	-	-	1	2	2
	CO4	2	2	1	-	-	-	-	-	-	-	-	-	2	1	3

Unit-1: **12 hours**

Spark Ignition Engines: Spark ignition Engine mixture requirements - Feedback Control Carburetors – Properties of Fuel - Injection systems –Mono point and Multipoint injection – Gasoline Direct Injection.

Combustion is SI engine: Stages of combustion –Ignition Lag-Flame propagation- Normal and Abnormal combustion- Detonation or knock-Factors affecting knock - Combustion Chambers types and designs.

Unit-2: **12 hours**

Properties of Fuel: Fuel sprays behavior - spray structure - spray penetration and evaporation – Air motion - Turbo charging – Supercharging, objectives, super charging of CI Engine -Cooling and Lubrication Systems.

Compression Ignition Engines: States of combustion in C.I. Engine - Diesel knock methods of controlling diesel knock- Direct and indirect injection systems – Combustion chambers type and design.

Unit-3: **12 hours**

Engine emissions and their control: Pollutant - Sources and types - formation of NOx - Hydrocarbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions- Catalytic converters and Particulate Traps-Selective Catalytic Reduction(SCR)-Diesel Oxidation Catalyst(DOC)-Methods of measurements – Emission Norms and Driving cycles. Diesel smoke and its control- Diesel odour and its control.

Unit-4: **12 hours**

Alternate Fuels and Recent trends in IC engines: Alcohol - Hydrogen - Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas- Properties - Suitability - Engine Modifications - Merits and Demerits as fuels.

Recent trends in IC engines: LHR Engines-Learn Burn Engines Stratified charge spark ignition engine – Homogeneous charge compression Ignition- Plasma Ignition – Electric/Hybrid Vehicles-
Electronic Engine Management.

Text books

1 R.B.Mathur and R.P.Sharma, (2002), Internal Combustion Engines., Dhanpat Rai & Sons
2. Ganesan V. (1999), Internal Combustion Engines, Tata McGraw Hill.

Reference books

1. Colin R.Feriguson, and Allan.T.Kirkpatrik, (2000), I.C.engines Applied Thermo sciences
2. John B. Heywood, (2000), Internal Combustion Engine Fundamentals, McGraw Hill.
3. Rowland S.Benson and N.D.White house, (2000) Internal combustion Engines, Vol. I and II, Pergamon Press.
4. Richard.L.Bechfold, Alternative Fuels Guide Book, SAE International Warrendale,1997.
5. "Alcohols as motor fuels progress in technology" - Series No.19 - SAE Publication

PROCESSING OF MATERIALS IN MANUFACTURING

Subject Code	BTME15F5620	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisite:

Course Objectives:

1. To provide students with fundamental concepts of material processing in engineering
2. To introduce them to metal casting processes and composite reinforcement

Course Outcomes:

After successful completion of the course, the students will be able to

1. Understand advanced manufacturing processes
2. Possess the knowledge of fibre reinforcement and techniques

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME15 F5620	CO1	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1
	CO2	2	1	1	-	-	-	-	-	-	-	-	-	2	2	1

Unit-1: **12 hours**

Introduction to the course and design projects, Intro. To CAD/CAM, engineering materials.Rapid prototyping; Stereolithography (STL), 3D ink jet printing, Fused-Deposition Method (FDM), Manufacturing polymers (plastics)

Unit- 2: **12 hours**

Manufacturing Processes Classifications, Mechanical properties of material and most commonly materials used. Design for Manufacture and Assembly, Introduction to Computer Numerical Control (CNC), Controllers, tool path, part programming. CNC – Electrical - Discharge Machining (EDM), CNC – Laser and water jet machining

Unit-3: **12 hours**

Metal-Casting processes; Expendable mold, Permanent mold, Design consideration for casting, Bulk deformation process – Forging, Bulk deformation process – Rolling, Bulk deformation process– Extrusion, wire drawing, Sheet metal forming – Design considerations, Powder Metallurgy, design considerations

Unit-4: **12 hours**

Composites; reinforcement fibers, matrix material, Machining processes, Fabrication techniques for composites, powder metallurgy, stir casting, Injection molding, Filament winding, Pultrusion.

Textbooks:

1. Kalpakjian, S., and Schmid, S.R., Manufacturing Processes for Engineering Materials, 5th edition, Prentice Hall Publishers, 2008
2. George E. Dieter, Mechanical Metallurgy.

STATISTICAL QUALITY CONTROL

Subject Code	BTME15F5630	IA Marks	: 25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	: 3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	: 50

Prerequiste: Basic Mathematics

Course Objectives:

1. Introduce the concept of SQC
2. Understand process control and acceptance sampling procedure and their application.
3. Learn the concept of reliability

Course Outcomes:

After successful completion of the course, the students will be able to

1. Understand the attributes in process control.
2. Appreciate the role of sampling procedure.
3. Understand the system reliability.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F563 0	CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2
	CO2	3	2	2	-	-	-	-	-	-	-	-	-	1	2	2
	CO3	3	1	3	-	-	-	-	-	-	-	-	-	2	1	2

Unit-1 **12 hours**

Introduction and Process Control for Variables

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost-Variation in process- factors – process capability– process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σ chart.

Unit-2 **12 hours**

Process Control for Attributes

Control chart for attributes –control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

Unit-3 **12 hours**

Acceptance Sampling: Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and Consumer's Risk. AQL, LTPD, AOQL concepts- standard sampling plans for AQL and LTPD- uses of standard sampling plans.

Unit-4 **12 hours**

Life Testing – Reliability Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

Use of software tool for data analysis-hand's on.

Text Books:

1. Grant, Eugene .L Statistical Quality Control, McGraw-Hill, 7th Edition 2006.
2. L .S.Srinath, Reliability Engineering, Affiliated East west press, 4th Edition , 2009.

References:

1. Monohar Mahajan, Statistical Quality Control, Dhanpat Rai & Sons, 2001.
2. R.C.Gupta, Statistical Quality control, Khanna Publishers,6th Edition , 2003.
3. Besterfield D.H., Quality Control, Prentice Hall, 1993.
4. Sharma S.C., Inspection Quality Control and Reliability, Khanna Publishers, 2002.

POWER PLANT ENGINEERING

Subject Code	BTME15F5640	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisite: Engineering Thermodynamics, Applied thermodynamics, Fluid Mechanics and Machinery

Course Objectives:

1. To explore various methods of power generation using various resources.
2. To understand working principle of different types of boilers and their accessories
3. To describe the benefits and limitations of various types of power plants.
4. To analyze the cost effectiveness with regard to power plant conception to application

Course Outcomes:

After successful completion of the course, the students will be able to

1. Discuss the working principle of the power plant.
2. Describe the particular methods to be used in power plant.
3. Identify the benefits and limitations of working processes used in the power plant.
4. Evaluate the economic analysis of various power plants.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F5640	CO1	2	2	2	-	-	-	-	-	-	-	-	-	2	2	2
	CO2	2	2	3	-	-	-	-	-	-	-	-	-	2	3	3
	CO3	2	1	2	-	1	-	-	-	-	-	-	-	2	2	3
	CO4	3	2	3	1	-	-	-	-	-	-	-	-	3	3	3
	CO5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	2

UNIT - 1

Steam Power Plant: Different types of fuels used for steam generation, Equipment for burning coal in lump form, strokers, different types, Equipment for preparation and burning of pulverised coal, unit system and bin system. Pulverised fuel furnaces, cyclone furnace. 6 **Hours**

Coal, Ash Handling and Different Types of Boilers : Coal and Ash handling, Generation of steam using forced circulation, high and supercritical pressures. **6 Hours**

UNIT - 2

Chimneys, A brief account of LaMount, Benson, Velox, Schmidt, Loeffer and Ramson steam generators.**Accessories for the Steam Generator Cooling Towers And Ponds:** Natural, forced, induced and balanced draft. Accessories For The Steam Generator such as super-heaters, de-super heater, Economisers, Air Pre-heaters Study of different types of cooling towers and ponds.

6 Hours

Diesel Engine: Method of starting diesel engines, Cooling and lubrication system for the diesel engine. Filters, centrifuges, Oil heaters, Intake and exhaust system, Layout of a diesel power plant. **6 Hours**

UNIT -3

Hydro-Electric Plants: Storage and pondage, flow duration and mass curves, hydrographs, Low, medium and high head plants, pumped storage plants, Penstock, water hammer, surge tanks, gates and valves, power house, general layout. A brief description of some of the important Hydel Installations in India., Numericals. 6 **Hours**

Nuclear Power Plant: Principles of release of nuclear energy Fusion and fission reactions. Nuclear fuels used in the reactors. Elements of the Nuclear reactor, Moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types - Pressurized water reactor, Boiling water reactor, Sodium

graphite reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Radio active waste disposal. 6 **Hours**

UNIT - 4

Choice of site for power station, load estimation, load duration curve, load factor, capacity factor, use factor, diversity factor, demand factor, Effect of variable load on power plant, selection of the number and size of units. **6 Hours**

Economic Analysis of power plant: Cost of energy production, selection of plant and generating equipment, performance and operating characteristics of power plants, tariffs for electrical energy.

6 Hours

TEXT BOOKS:

1. **Power Plant Engineering**, P.K Nag, 3rd Ed. Tata McGraw Hill2nded 2001,
2. **Power Plant Engineering.** Morse F.T., Van Nstrand.1998

REFERENCE BOOKS:

1. **Water Power Engg**., Edition 3, Barrows, TMH, New Delhi. 1998
2. **Plant Engg. Hand Book**, Stanier, McGraw Hill. 1998
3. **Hydraulic Machines**, Jagadish Lal, Metropollitan Co 1996.
4. **Principles of Energy Conversion**, A.W. Culp Jr., McGraw Hill. 1996
5. **Power Plant Technology**, M.M. EL-Wakil, McGraw Hill, International. 1994
6. **Power Station Engg. Economics**, Skrotizke and V opat. 1994
7. **Power Plant Engineering,** Domakundawar, Dhanpath Raisons.2003

FLUID MACHINERY LAB

Subject Code	BTME15F5700	IA Marks	10+15=25
Lecture-Tutorial-Practical (LTP)	2-0-0=2	Exam Hrs	3
Total No. of Contact Hrs. per Week	2-0-0=2	Exam Marks	25

Prerequisite: Fluid mechanics

Course Objectives:

1. To understand the various fluid flow measuring devices and find discharge.
2. To learn the testing procedure of the pumps and compressor.
3. To learn the procedure used to conduct performance test of the turbines.
4. To understand the performance characteristics of the fluid machineries.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Apply the concept of friction to find losses when the fluid passes through pipes and pipe fittings
2. Evaluate the performance of pumps and compressor by conducting experiments.
3. Conduct the performance test on the turbine and interpret the data with theoretical values.
4. Prepare the document based on the experiment/test conducted.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F570	CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2
	CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2

0	**CO3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**
	CO4	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

PART-A

(Individual Experiments)

1. Determination of coefficient of friction of flow in a pipe.
2. Determination of minor losses in flow through pipes.
3. Determination of force developed by impact of jets on vanes.
4. Calibration of flow measuring devices:
    a. Orifice plate meter b. Nozzle c. Venturi meter d. V-notch

PART-B

(Group Experiments)

1. Performance testing of Turbines
    a. Pelton Wheel b. Francis Turbine c. Kaplan Turbine
2. Performance testing of Pumps
    a. Single stage/Multistage Centrifugal pumps b. Reciprocating pumps
3. Performance test of a two stage Reciprocating Air Compressor.
4. Performance test on a Air Blower.

ENERGY CONVERSION LAB

Subject Code	BTME15F5800	IA Marks	10+15=25
Lecture-Tutorial-Practical (LTP)	2-0-0=2	Exam Hrs	3
Total No. of Contact Hrs. per Week	2-0-0=2	Exam Marks	25

Prerequisite: Applied Thermodynamics

Course Objectives:

1. To conduct performance test on IC engines for different load conditions
2. To conduct Morse test on multi cylinder engine.
3. To know the various heat losses by drawing heat balance sheet.
4. To determine area of regular and irregular geometrical figures
5. To determine the flash point, viscosity of lubricating oils

Course Outcomes:

After successful completion of the course, the students will be able to

1. Determine the IP, BP, SFC, BSFC, ISFC of the engines under different load conditions and Identify the angular displacements in valve timing diagram
2. Calculate the area of regular and irregular geometrical surfaces.
3. Evaluate the frictional power by conducting Morse test on multi cylinder engine
4. Determine the flash point and viscosity of lubricating oils

Mapping of Course Outcomes with Programme Outcomes

Course Code	**POS/ COs**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**P 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
BTME 15F580	**CO1**	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**
	CO2	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

0	**CO3**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
	CO4	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**

PART – A

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleavland's (Open Cup) Apparatus.
2. Determination of Calorific value of solid, liquid and gaseous fuels.
3. Determination of Viscosity of a lubricating oil using Redwoods, Saybolt and Torsion Viscometers.
4. Valve Timing/port opening diagram of an I.C. engine (4 stroke/2 stroke).
5. Use of planimeter

PART - B

1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, Volumetric efficiency, Mechanical efficiency, SFC, FP, A:F Ratio heat balance sheet for

(a) Four stroke Diesel Engine
(b) Four stroke Petrol Engine
(c) Multi Cylinder Diesel/Petrol Engine, (Morse test)
(d) Two stroke Petrol Engine
(e) Variable Compression Ratio I.C. Engine.

CAD/CAM/CIM

Subject Code	BTME15F6100	IA Marks	: 25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	: 3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	: 50

Prerequisite: Manufacturing Technology I and II

Permeable

Computers have become pervasive in all walks of life. Its impact has enhanced in the industrial scenario with a substantial changes in the working environment which has simplified many of the traditional manufacturing tasks & impossible for any manufacturing industry to survive in the modern era in order to compete in the global market. CAD/CAM attempts to integrate the various stages of product design and development with a "Geometric Model", created from fundamentals of computational geometry (CG). Latest techniques of geometric modeling (Feature based or parametric modeling etc) and manufacturing like Rapid prototyping (RP) have bridged a gap between product conceptualization and product realization. A versatile Geometric Model can characterize all physical properties of real component and can incorporate all types of simulations and can quickly generate the modified outcomes (i.e., Production drawings) for a predefined set of design rules. The benefits extend beyond design to engineering analysis, manufacturing and inspection which can be automated and integrated with the design. Present day CAD/CAM packages (Pro-E, ANSYS, Solid works, CATIA, Solid edge, Unigraphic's NX, NISA, MTAB, Espirit, Edge cam, Cadem etc.) are capable of generating a versatile geometric model that can be used for simulation and evaluation of all probable practical conditions. Use of CAD/CAM technologies enables the user to make accurate and precise changes in the geometric models, production drawings and simulation at any stage of the Product Design and Development Cycle. The integration of CAD and CAM which known as CIM also plays a vital role in the manufacturing sector in order to produce very high precision components with accurate dimensional stability. The key challenges such as integration of components, data integrity and process control can be achieved by integration of CAD/CAM/CIM. Thus, through the integration of computers, manufacturing can be faster and less error-prone.

Course Objectives:

1. To learn the fundamentals of CAD/ CAM / CIM and related concepts to understand the various modelling features and its manufacturing.
2. To understand how by integrating 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. To understand the concept of programming and its importance in practical applications in order have an edge cut manufacturing aspects.
4. To have a hands on experience on various tools used for modelling and manufacturing aspects.
5. To study about the programming aspects by using machine code languages for various operations using sophisticated software's (Manual and computer aided part programming)

Course Outcomes:

After successful completion of the course, the students will be able to

1. Students can able to analyze the basic principles of CAD & CAM in engineering applications.
2. Application of Computers in manufacturing aspects.
3. Geometrical modelling of an component by using Software
4. Generation of part programming by using machine language codes.

5. This subject is an prerequisite for an analysis, which will be helpful for project work..
6. Reduction of Manufacturing Lead time and Product development time.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F6100	CO1	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
	CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
	CO3	2	2	2	3	-	-	-	-	-	-	-	-	1	2	3
	CO4	2	1	3	2	-	-	-	-	-	-	-	-	2	3	3
	CO5	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1
	CO6	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1

Unit- 1

Fundamentals of CAD

Definition of CAD/CAM, Product cycle and its cad / cam overlaid, Design process & application of computers for design, creating the manufacturing database, Benefits and achievement of CAD. Hardware in CAD: Basic Structure, CPU, Memory Types, Input Devices, Display Devices, Hard Copy Devices, Storage Devices, Software. **6 Hrs**

Computer Graphics: Raster Scan Graphics, Coordinate Systems, Database Structure for Graphic Modeling, functions of graphics package, Transformation of geometry, 2D transformations – Simple problems. Geometric Modelling: Requirements for geometric modeling, Geometric Models,

Geometric Based Modelling, Constrain Based Modelling, Curve Representation, Surface Representation methods. Windowing and clipping**.** **6 Hrs**

Unit-2

Introduction to NC technology:

Basic components of NC system, Where NC is most appropriate, NC Coordinate system, types of NC motion control systems, advantages and applications of NC, influence of computers in manufacturing environment. CNC & DNC Systems: Types, advantages and its functions. Adaptive control systems, types of CNC turning centers and machining centers. **6 Hrs**

NC/CNC Programming:

NC Procedure, Programming: Manual and adaptive part programming, Block formats in part programming, G & M codes, Cutter Radius Offset, Tool Length Offset, Fixed Cycles/canned cycles, Turing programs, Drilling and milling programs. 6 Hrs

Unit-3

Computer integrated Manufacturing System:

Introduction, Automation definition, Types of Automation, CIM processing in Manufacturing, Types of Production, Production Concepts & its Mathematical models, Problems on mathematical model equations, Automation Strategies, CIM information processing cycle, Costs of Manufacturing operations.

6 Hrs

High Volume Production system:

Introduction, Automated flow line, Work part transport, Transfer Mechanism, Buffer storage and its control functions, Automation for machining operations.

Computerized Manufacturing Planning system: Computer aided process planning and MRP **6 Hrs**

Unit-4

Analysis of Automated Flow line:

General terminology and analysis, Analysis of Transfer line with and without storage with numerical problems, Partial automation with numerical problems, Flow lines with more than two stages-numerical.

6 Hrs

Assembly and Line balancing

Manual Assembly lines, Types of automated assembly system, Parts feeding devices.

Minimum rational work element, cycle time. Precedence constraints and diagram, Balance delay. Methods of Line balancing – Largest candidate rule, Kilbridge and westers method, RPW method and numerical problems covering above methods and computerized line balancing. **6 Hrs**

Text Books:

1. CAD/CAM, Computer Aided Design and Manufacturing, M.P.Groover & Emory W.Zimmer, Pearson India, 2007 2nd edition.
2. Automation, Production system & Computer Integrated Manufacturing, Mikell P.Groover, Pearson India, 2007 2nd edition.

Reference Books:

1. CAD/CAM theory and practice by Ibrahim Zeid, Tata McGraw hill.
2. CAD/CAM/CIM by P.RadhaKrishnan, S.Subramanyan & V.Raju, New Age international Publishers , 2nd edition.
1. Computer Numerical Control Machines and CAM by P.RadhaKrishnan, New Age international Publishers, 1st edition 2012.
2. CAD/CAM Principles and applications by P.N.Rao, Tata McGraw hill.

MACHINE DESIGN – II

Subject Code	BTME15F6200	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-2-0=5	Exam Marks	50

Prerequisite: Knowledge of mechanics, Material science, and Strength of materials, Theory of Machines

Preamble

In machine design certain topics were discussed in detail. In the course Machine Design -2 some more components for complete design are considered. This enables the person who undergoes the course understanding the subject as below.

Course Objectives:

1. To carry out the design of curved beams used in Crane hook, punching presses, clamps, closed rings and links and flexible machine elements like belts, chains, ropes.
2. To experience the design of gears such as spur, helical, bevel and worm gears.
3. To know the design of various types of springs and Bearings.
4. To carry out the design of clutches, brakes used in automotives and I.C.Engine parts like piston, connecting rod.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Clear understanding of the design of curved beams, belts, chains, ropes.
2. Knowledge about the detailed design of various gears such as spur, helical, bevel and worm gears.
3. Detailed procedure of the design processes of machine members like springs, bearings, clutches, brakes, and I.C.Engine parts like piston, connecting rod.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F620 0	CO1	3	3	3	1	-	1	-	-	-	-	-	-	2	2	2
	CO2	3	3	3	1	-	1	-	-	-	-	-	-	2	2	1
	CO3	3	3	3	1	-	1	-	-	-	-	-	-	2	2	1

Unit: 1 **14 hours**

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

Design of Belt, ropes and chain drives: Belt Drives, design of flat belts, Selection of V- belts, Rope drives-selection of wire ropes, Chain drives- Roller chains, design & selection of roller Chain drives.

Unit: 2 **14 hours**

Springs: Types of springs - Energy stored in springs, stresses in Helical coil springs of circular and non-circular cross sections. Tension and compression springs, Springs under fluctuating loads, Leaf Springs: Stresses in leaf springs. Equalized stresses, Belleville springs.

Clutches & Brakes: Design of Clutches: Single plate, multi plate and cone clutches. Design of Brakes: Block and Band brakes, self-locking of brakes, Heat generation in Brakes.

Unit: 3 **16 hours**

Design of Gears:

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

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

Unit: 4 **14 hours**

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

Worm Gears: Definitions, Design based on strength, dynamic, wear loads and efficiency of worm gear drives.

Text Books:

1. Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Machine Design, R.S. Khurmi & J.K.Gupta, S. Chand Publications.

Reference Books:

1. Machine Design, Dr.P.C.Sharma & Dr.D.K.Aggarwal,S.K.Kataria and Sons, New Delhi.
2. Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2009.

Design Data Handbook:

1. Design Data Hand Book, K. Lingaiah, McGraw Hill, 2nd Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBSPublication
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher,2010.

FINITE ELEMENT METHOD

Subject Code	BTME15F6300	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-2-0=5	Exam Marks	50

Prerequisite: Knowledge of mechanics and strength of materials

Preamble

Finite Element Method is proving to be a very powerful technique of solving and analyzing complex engineering problems. It is a numerical method which yields fairly accurate results for complex

engineering problems and of late has emerged as a very rapidly growing area of research for applied mathematics. Its usefulness in various branches of engineering is due to the ease with which the method is made amenable to computer programming, leading to a process of iterative design. Its uniqueness lies in the fact that complex engineering problems having no analytical solutions can be solved with ease and iterative designs can be worked out. Of late, this technique has found a lot of applications in the area of manufacturing as newer and specialized techniques and materials are being used with changing technology. In this context it is desirable to introduce the subject of FEM in the curriculum of BE course as an open elective for other branches to train the students for developing skills for designing and analyzing the various manufacturing processes to arrive at an optimized process. The method can also be used in the development of machine tools, newer materials and failure analysis of processes.

Course Objectives:

1. To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics, heat transfer and fluid flow problems.
2. Provide systematic and comprehensive knowledge of basics of Finite element method as an analysis tool.
3. To teach the students the characteristics of various elements and selection of suitable elements for the problems being solved.
4. To make the students derive finite element equations for simple and complex elements.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Understand the different types of analysis methods
2. Analyze the bar and beam problems by Euler-Lagrange equations
3. Understand principle of minimum potential energy
4. Analyze the bar problems using elimination and penalty approach
5. Apply Lagranage's equation for Higher order elements
6. Solve truss problems using elimination approach
7. Derive Hermite Shape function and apply it to solve beam problems
8. Apply FEM method to solve 1D heat transfer problems

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BTME15F6300	CO1	3	3	1	1	1	-	-	-	-	-	-	-	3	3	2
	CO2	2	3	2	2	1	-	-	-	-	-	-	-	2	3	3
	CO3	3	3	1	1	-	-	-	-	-	-	-	-	3	3	3
	CO4	3	3	1	1	1	-	-	-	-	-	-	-	3	2	2
	CO5	2	3	2	1	1	-	-	-	-	-	-	-	3	3	3
	CO6	3	3	1	1	-	-	-	-	-	-	-	-	2	3	3

	CO7	**3**	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**
	CO8	**2**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**

UNIT – 1 **14 hours**

Introduction: Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Steps involved in FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Elements of variational calculus -Euler Lagrange equation, Rayliegh Ritz method, Weighted Residual methods, Galarkin method.

UNIT – 2 **16 hours**

Interpolation Models: Interpolation polynomials- Linear, quadratic and cubic. Simplex complex and multiplex elements.2D PASCAL's triangle. CST elements-Shape functions and Nodal load vector, Strain displacementmatrix and Jacobian for triangular element.

Solution of 1-D Bars: Solutions of bars and stepped bars for displacements, reactions and stresses by using penalty approach and elimination approach. Guass-elimination technique.

UNIT –3 **14 hours**

Higher Order Elements: Langrange's interpolation, Higher order one dimensional elements-Quadratic and cubic element and their shape functions. Shape function of 2-D quadrilateral element-linear, quadric element Isoparametric, Sub parametric and Super parametric elements. Numerical integration : 1 and 2 gauge point for 1D case.

Trusses: Stiffness matrix of Truss element. Numerical problems

UNIT – 4 **14 hours**

Beams: Hermite shape functions for beam element, Derivation of stiffness matrix. Numerical problems of beams carrying concentrated, UDL and linearly varying loads.

Heat Transfer: Steady state heat transfer, 1D heat conduction governing equations.Functional approach for heat conduction.Galerkin's approach for heat conduction.

TEXT BOOKS:

1. **Finite Elements in Engineering**, T.R.Chandrupatla, A.D Belegunde, 3rd Ed PHI.

2. **Finite Element Analysis**, S.S. Bhavikatti, New Age International publishers,2006

REFERENCE BOOKS:

1. **"Finite Element Methods for Engineers"** U.S. Dixit, Cengage Learning, 2009

2. **Concepts and applications of Finite Element Analysis**, R.D. Cook D.S Maltus, M.E Plesha, R.J.Witt, Wiley 4th Ed, 2009

3. **Finite Element Methods**, Daryl. L. Logon, Thomson Learning 3rd edition, 2001.

4. **Finite Element Method**, J.N.Reddy, McGraw -Hill International Edition.

HEAT AND MASS TRANSFER

Subject Code	BTME15F6400	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-1-0=4	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-2-0=5	Exam Marks	50

Prerequisite: Basic and Applied Thermodynamics

Course Objectives:

1. Provide sound understanding of the basic principles and laws governing the heat and mass transfer.

2. To familiarize with the various modes of heat transfer, combined heat transfer processes and special heat transfer processes.
3. To provide capability to analyze and solve practical problems from basic principles and provide numerical solutions.
4. To analyze complex heat transfer problems and provide solutions using heat transfer data hand book.
5. Carryout analysis of boiling and condensation phenomenon and design heat transfer equipments.
6. Conduct experiments related to various heat transfer processes and heat exchangers and analyze measurement data.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Understanding of the basic principles and laws governing the heat and mass transfer.
2. Knowledge of the various modes of heat transfer, combined heat transfer processes and special heat transfer processes and its application.
3. Capability to analyze and solve practical problems from basic principles and provide numerical solutions.
4. Capability to analyze complex heat transfer problems and provide solutions using heat transfer data hand book.
5. Capability to analyze and provide solutions for the design of heat transfer equipment.
6. Familiarization with the experimental methodology and ability to solve problems.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F640 0	CO1	3	3	1	-	-	-	-	-	-	-	-	-	3	3	3
	CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	3	3
	CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	3	3
	CO4	3	3	2	1	-	-	-	-	-	-	-	-	3	3	3
	CO5	3	3	2	-	-	-	-	-	-	-	-	-	3	3	3
	CO6	3	3	2	1	-	-	-	-	-	-	-	-	3	3	3

Unit-1: **14 hours**

Introduction: Modes of Heat Transfer, Basic Laws of Heat Transfer, Overall Heat Transfer Coefficient, thermal contact resistance, Boundary Conditions, 3-D Conduction Equation in Cartesian Coordinates, Discussion On 3-D Conduction Equation in Cylindrical and Spherical Coordinate Systems (No Derivation). 1-D steady state heat conduction without heat generation through plane slabs, cylinders and spheres with uniform thermal conductivity (Discussions only). Heat transfer through composites and applications. Numerical examples.

Critical thickness of insulation without heat generation and Theory of Fins-Types of fins, Governing equations for different conditions of fins(no derivations), Fin effectiveness and fin efficiency, Numerical examples.

One –Dimensional Transient Conduction: Lumped parameter Analysis, Use of Heisler's Charts for transient conduction in plane slab, long cylinder and sphere. Numerical examples.

Unit-2: **16 hours**

Concepts and basic relations in boundary layers: Hydrodynamic and thermal boundary layers over flat plate, critical Reynolds number, local heat transfer coefficient, average heat transfer coefficient, Flow inside a duct, hydrodynamic and thermal entrance lengths.

Natural or Free convection: Application of dimensional analysis for free convection –physical significance of Grasshoff number, use of correlations in free convection for horizontal, vertical flat plates, cylinders and spheres. Numerical examples.

Forced convection heat transfer: Application of dimensional analysis for forced convection problems. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of correlations for hydro-dynamically and thermally developed flows in case of a flow over a flat plate, a cylinder and sphere. Numerical examples.

Unit-3: **16 hours**

Radiation Heat Transfer: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchhoff's law, Planck's law and Wien's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces configuration factor or view factor. Numerical problems.

Mass transfer: Definition and terms used in mass transfer analysis, Fick's First law of diffusion convective mass transfer, (no numerical).

Unit-4: **14 hours**

Heat Exchangers: Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical examples.

Condensation And Boiling: Types of condensation (discussion only) Nusselt's theory for laminar condensation on a vertical flat surface(no derivations) use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations. Numerical examples.

TEXT BOOKS:

1. Heat & Mass transfer, Tirumaleshwar, Pearson education 2006
2. Heat transfer-A basic approach, Ozisik, Tata McGraw Hill 2002

REFERENCE BOOKS:

1. Heat transfer, a practical approach, Yunus A- Cengel Tata Mc Graw Hill
2. Principles of heat transfer, Kreith Thomas Learning 2001
3. Fundamentals of heat and mass transfer, Frenk P. Incropera and David P. Dewitt, John Wiley and son's.
4. Heat transfer, P.K. Nag, Tata McGraw Hill 2002.
5. Heat and mass transfer, Mahesh M Rathore, Laxmi publications.

REFRIGERATION AND AIR-CONDITIONING

Subject Code	BTME15F6510	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisite: Applied Thermodynamics

Course Objectives:

1. To enable the students to understand the principles of refrigeration and air conditioning
2. To teach the students how to calculate the cooling load for different applications of Refrigeration and Air-conditioning
3. To expose the students to cyclic controls and system balancing
4. To teach students the principles of psychrometry

5. To develop the knowledge of students in selecting the right equipment for a particular application of Refrigeration and Air-conditioning

Course Outcomes:

After successful completion of the course, the students will be able to

1. Possess the knowledge of system components of refrigeration and air conditioning Design and implement refrigeration and air conditioning systems using standards
2. Apply the knowledge of psychrometry in calculating cooling load and heating load calculations
3. Able to calculate load and select the size of the components.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F6510	CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	2	1
	CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2
	CO3	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1

Unit-1

Refrigeration Cycles and System: Brief discussion about Vapour compression refrigeration cycles and actual vapour compression cycle(detail discussion) Air refrigeration cycles(In brief)-Aircraft refrigeration system- various types- numerical on aircraft refrigeration system. Multi stage compression – Multi evaporator system-cascade system-simple numerical. Vapour absorption systems-Lithium bromide, three fluid vapour absorption systems. **12hrs**

Unit-2

Refrigerants and Refrigeration Components:- Refrigerant classification–primary and secondary refrigerants. Designation—Detail discussion about selection of refrigerants, CFC'S, HCFC's and HFC's. Global warming and Ozone depleting aspects. Alternate refrigerants, Refrigerant absorbent combinations for vapor absorption system Refrigerant compressors Reciprocating –Rotary type, Condensers, Evaporators, Expansion devices, Low side-high side float, low pressure and high pressure cut outs, solenoid valves. **12hrs**

Unit-3

Psychrometry and Load Estimation:-Review of Moist air properties-various psychrometric process, psychrometric chart. Zoned, central, unitary system. Load estimation-comfort chart-SHF-GRSHF-ERSHF, cooling load estimate, heating load estimate, solar heat gain, infiltration, internal heat gain, Numerical on load estimation. **12hrs**

Unit-4

Air-conditioning Equipments:- Package unit, central unit. Air distribution system-principles- air handling system, ducts and its arrangements, filters, fans, room air distribution- supply air outlets.

Application of Refrigeration and Air-conditioning:- Food preservation-necessary-food freezing-various types, cold storage plants, Domestic refrigerator-construction and working and maintenance, Water coolers-storage type and pressure type, Dessert cooler, Window air conditioners, split air conditioners-Discussion on one case study on design and installation of Centralized air conditioning system for Hospital/Hotel/commercial complex/Software company etc,. **12hrs**

Text Books

1. W. F. Stocker and J. W. Jones, (2002), Refrigeration and Air conditioning, McGraw Hill.
2. R K Rajput "Refrigeration and Air conditioning" second edition, S K kataria and sons

References

1. Manohar Prasad, (1998), Refrigeration and Air conditioning, Wiley Eastern Ltd.
2. Arora, C. P., (2007), Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing
3. Company Ltd.
4. S. C. Arora and Dumkundwar, (1996), Refrigeration and Air-Conditioning, Dhanpathrai Publishers.

Manufacturing Technology – III

Subject Code	BTME15F6520	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisite: Manufacturing Technology II

Preamble : Manufacturing Technology-III is completely related to study of various metal forming processes. By this process, desired size & shape is obtained on the component through the plastic deformation of the material. The components obtained from this process can be used for critical applications. The present course deals with various forming methods such as forging, rolling, bending, extrusion, sheet metal forming & HERF processes.

Course Objectives:

1. The course will enable the students to acquire a fundamental knowledge on metal forming technology which is necessary for an understanding of industrial processes.
2. To introduce students to the wide range of materials and processes, which are currently used in manufacturing industry.
3. The course will also provide methods of analysis allowing a mathematical/physical description of forming processes.
4. The course will enable the students to identify the processes characteristics, select the main operator parameters, the tool geometry and materials, and determine forces and power required to select the main and auxiliary equipment.

Course Outcomes:

After successful completion of the course, the students will be able to

1. The students should learn and understand necessity of forming process compared with other manufacturing techniques
2. The learning of various methods of forming gives an idea for the selection of a process for different materials
3. The students should know the parameters effect on the processing of the wrought products.
4. Students should be able to select the process, load required and possible reasons for the formation defects of the forged components
5. The students should have the knowledge to identify and analyze production of wire, rod , tubes using different processes and problems occurred in the process
6. They can select the different process, related equipments, parameters for the fabrication of various sheet metal components
7. They can able to select the different high energy rate forming process suitable for fabrication of bulk sheet metal components.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BTME15F6520	CO1	3	2	1	3	-	-	-	-	-	-	-	-	2	2	2
	CO2	3	-	1	-	-	-	-	-	-	-	-	-	1	1	1
	CO3	3	3	-	-	-	-	-	-	-	-	-	-	1	1	1
	CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2
	CO5	3	2	1	3	-	-	-	-	-	-	-	-	2	2	2
	CO6	3	-	1	-	-	-	-	-	-	-	-	-	1	1	1
	CO7	3	3	-	-	-	-	-	-	-	-	-	-	1	1	1

Unit-1: Introduction And Concepts:

Classification of metal forming processes, Hot working and cold working , advantages and limitations of metal working processes. Concepts of true stress and true strain, Relationship between conventional and true strain, Stress system, Yield criteria, ,concepts of plane stress & plane strain, Numerical problems. **(06 hrs)**

Variables in Metal forming: Temperature in metal forming, strain rate or Deformation velocity, Grain size and microstructure, Friction in metal forming, Lubrication in metal forming, Formability of materials, Deformation zone geometry, hydrostatic pressure, Residual stresses in metal working. **(06 hrs)**

Unit-2: Forging:

Introduction. Forging operation, Classification of forging processes, Forging machines & equipment: power hammer and power presses. Grain flow in forging, Expressions for forging pressure and loads. Forging die design parameters, Defects in forging, Residual stresses in forging. Simple problems. **(06 hrs)**

Rolling:

Introduction, Terminology of shapes produced in rolling, Classification of Rolling processes. Types of rolling mills, Forces and geometric relationship in rolling, Roll separating force, power required in rolling, Front and back tension in rolling, Maximum possible reduction in rolling, Rolling variables, Defects and numerical problems. **(06 hrs)**

Unit-3: Drawing:

Rod drawing, wire drawing, Dies for drawing, Tube drawing, Expression for Drawing load by slab analysis, Defects in Drawn products. Redundant work and its estimation, optimal cone angle & dead zone formation, drawing variables, simple problems. **(06 hrs)**

Extrusion: Introduction, Methods of extrusion, extrusion equipment & dies, Extrusion process parameters and variables, Expression for extrusion force, Extrusion of seamless tubes, Deformation lubrication and defects in extrusion, simple problem. **(06 hrs)**

Unit-4: Sheet & Metal Forming:

Introduction, Sheet metal forming methods, Dies and punches, Rubber forming. Stretch forming, LDR in drawing, Forming limit criterion, defects in deep drawn products, piercing, blanking, bending, deep drawing, stretch forming, Die and punch design parameters in deep drawing, simple problems. **06 hrs)**

High Energy Rate Forming Methods and Powder Metallurgy: Introduction, Principles, advantages and applications, explosive forming, electro hydraulic forming, Electromagnetic forming. Basic steps in Powder metallurgy, methods of production of metal powders, conditioning and blending powders, compaction and sintering, hot pressing, finishing and inspection, application of powder metallurgy components, advantages and limitations. **(06 hrs)**

Text Books:

1. Mechanical metallurgy (SI units), G.E. Dieter, Mc Graw Hill pub.2001
2. Manufacturing Process – III, Dr. K.Radhakrishna, Sapna Book House, 2009.

Reference Books:

1. Materials and Processes in Manufacturing, E.paul, Degramo, J.T. Black, Ronald, A.K. Prentice -hall of India 2002
2. Principles of Industrial metal working process, G.W. Rowe, CBSpub. 2002
3. Manufacturing Science, Amitabha Ghosh & A.K. Malik - East - Westpress 2001
4. Technology of Metal Forming Process, Surendra kumar, PHI –2008

PRODUCTION PLANNING & CONTROL

Subject Code	BTME15F6530	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Objectives:

1. Understand the process planning concepts
2. Prepare cost estimation for various products after process planning

Expected Outcome: The students should be able to:

1. Understand the characteristics of different types of tools and techniques available and their applications.
2. Approach the process planning activities, selection of machine based on process requirement and develop the manufacturing logic.
3. Determine data required for Cost estimation and estimate the production cost for different jobs.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O1	PS O2	PS O3
BTME 15F653 0	CO1	2	2	-	-	-	-	-	-	-	-	2	-	2	1	1
	CO2	2	2	-	-	-	-	-	-	-	2	-	-	1	2	2
	CO3	2	2	-	-	-	-	-	-	-	-	1	-	1	1	2

Unit-01

Introduction to Process Planning, Process Control and Forecasting: 14 hours

Definitions, Objectives of production Planning and Control, Functions of production planning and control, Elements of production control, Types of production, Organization of production planning and control department, Internal organization of department, Product design factors, Process Planning sheet.

Forecasting – Importance of forecasting, Types of forecasting, their uses , General principles of forecasting, Forecasting techniques– qualitative methods and quantitive methods- Opinion and Judgmental methods, Time Series methods, Exponential smoothing, Regression and Correlation methods (with numerical).

UNIT-02 14 hours

Operations Decision Making, aggregate planning and master scheduling

Introduction, Characteristics of decisions, framework for Decision Making, Decision methodology, Decision supports systems, Economic models, Statistical models. (With numerical)**.**

Introduction, Planning and Scheduling, Objectives of Aggregate Planning, Aggregate Planning Methods, Master Scheduling Objectives, Master Scheduling Methods. (with numerical)

UNIT-03 14 hours

Inventory Management, MRP and ERP:

Definition and Need, Components Inventory, inventory control. Functions of inventories, relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems. (with numerical)

Introduction to MRP & ERP, LOB (Line of Balance), JIT inventory, and Japanese concepts. System Parameters, MRP Logic, System refinements, Capacity Management, CRP activities. Concept of continuous improvement of process. (with numerical)

UNIT-04 14 hours

Routing , Supply Chain Management and Dispatching

Definition, Routing procedure, Route sheets, Bill of material, Factors affecting routing procedure.

Introduction to supply chain management- Approaches to purchase and supply chain management, make or buy decision, e-Procurement, Vender development, rating, and certification.
Activities of dispatcher, Dispatching procedure –follow up – definition -types of follow-up, applications of computer in production planning and control.

TEXT BOOKS:

1. Samuel Eilon, "Elements of Production Planning and Control", 1st Edition, Universal Publishing Corp., 1999.

REFERENCES:

1. P Rama Murthy, "Production and Operations Management", 1st Edition, New Age, 2002.
2. Baffa & Rakesh Sarin, "Modern Production / Operations Management", 8th Edition, John Wiley & Sons, 2002.
3. S.N. Chary, "Operations Management", 1st Edition, TMH, 1996.
4. Joseph Monks, "Operations Management Theory and Problems", 3rd Edition, McGraw-Hills,1987.

THEORY OF ELASTICITY

Subject Code	BTME15F6540	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisite: Strength of materials and Finite element methods

Course Objectives:

1. To obtain the stress strain relation within the elastic body.
2. Thermal distribution occurring within the elastic body.
3. To find the principle stress and strain for a different types of elastic body.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Solve two and three dimensional problems of cylindrical bodies.
2. Know the stress strain relation for a body subjected to loading within elastic limit.
3. Got the relation for a body subjected to thermal expansion.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15F6540	CO1	3	2	1	1	-	-	-	-	-	-	-	-	2	2	2
	CO2	3	3	1	1	-	-	-	-	-	-	-	-	2	2	2
	CO3	3	3	1	1	-	-	-	-	-	-	-	-	2	1	1

UNIT - 1

Definition And Notation: Stress, Stress at a Point, Equilibrium Equations, Principal Stresses, Mohr's Diagram, Maximum Shear Stress, Boundary Conditions.

Strain At A Point: Compatibility Equations, Principal Strains, Generalised Hooke's law, Methods of Solution of Elasticity Problems – Plane Stress- Plane Strain Problems. 12 **Hours**

UNIT - 2

Two Dimensional Problems: Cartesian co-ordinates – Airy's stress functions – Investigation of Airy's Stress function for simple beam problems – Bending of a narrow cantilever beam of rectangular cross section under edge load – method of Fourier analysis – pin ended beam under uniform pressure.

General Equations In Cylindrical Co-Ordinates: Thick cylinder under uniform internal and / or external pressure, shrink and force fit, stress concentration. 12 **Hours**

UNIT - 3

Stresses In An Infinite Plate (with a circular hole) subjected to uniaxial and biaxial loads, stress concentration, stresses in rotating discs and cylinders.

Torsion Of Circular, Elliptical And Triangular Bars: membrane analogy, torsion of thin open sections and thin tubes. 12 **Hours**

UNIT - 4

Thermal Stresses: Thermo elastic stress strain relationship, Equations of equilibrium Thermal stresses in thin circular discs and in long circular cylinder, sphere.

Uniqueness Theorem: Principle of super position, reciprocal theorem, saintvenant principle. 12 **Hours**

TEXT BOOKS:

1. **Advanced Mechanics of solids**, L. S. Srinath, Tata Mc. Graw Hill,2003
2. **Theory of Elasticity,** S. P. Timoshenko and J. N Gordier, Mc.Graw Hill International, 3rd edition, 1972

REFERENCES BOOKS:

1. **Theory of Elasticity,** Dr. Sadhu Singh, Khanna Publications, 1988
2. **Elasticity, Theory, Applications & Numericals,** Martin H Sadd, Elsevier. 2005
3. **Applied Elasticity,** Seetharamu & Govindaraju, Interline Publishing
4. **Applied Elasticity,** C.T. WANG Sc. D. McGraw Hill Book Co.1953

RENEWABLE ENERGY SOURCES

Subject Code	BTME15F6610	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisite: Concept of energy resources

Course Objectives:

1. To provide students an overview of global energy resources.
2. To introduce students to bio-fuels, hydrogen energy and solar energy.
3. To enable the students understand the importance of energy efficiency and conservation in the context of future energy supply.
4. To expose students to future energy systems and energy use scenarios with a focus on promoting the use of renewable energy resources and technologies.

Course Outcomes:

After successful completion of the course, the students will be able to Student will be able to

1. Possess the knowledge of global energy resources.
2. Use the renewable technologies like solar, biomass, wind, hydrogen etc. to produce energy.
3. Involve in optimizing and selecting an alternate source of energy.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
BTME15F6610	CO1	2	1	-	2	-	-	-	-	-	-	-	-	1	2	-
	CO2	2	2	-	2	-	-	-	-	-	-	-	-	1	2	1
	CO3	2	2	-	2	-	-	-	-	-	-	-	-	2	1	1

Unit-1: Introduction **14 hours**

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

Biomethanization: Anaerobic digestion, Basic principles, factors affecting biogas yield, biogas digestor (floating gas holder and fixed dome type with working principle and diagram),calculation for sizing biogas plant.

Unit-2: Hydrogen Energy: **14 hours**

Introduction to hydrogen energy, methods of hydrogen production(electrolytic and thermochemical method), hydrogen storage and transportation, safe burning of hydrogen.

Unit-3: Solar Energy and applications: **14 hours**

Solar radiation - Availability- Measurement and estimation- Solar radiation geometry-Flux on a plane surface, latitude, declination angle, surface azimuth angle, hour angle, zenith angle, solar altitude angle expression for the angle between the incident beam and the normal to a plane surface (No derivation) local apparent time, day length, simple numerical.

Introduction to solar collectors (liquid and air flat plate collectors-working principle with diagram), Thermal storage (Sensible and latent heat storage), Solar distillation- PV cell- solar furnace-solar green house-solar production of hydrogen(working principle with diagram).

Unit-4: Ocean Thermal Energy and Geothermal energy Conversion: **14 hours**

Geothermal energy- Availability - Geographical distribution - Power generation using OTEC - Wave and Tidal energy - Scope and economics - Limitations.

Wind Energy: Wind energy - General considerations - Wind Power plant design – Horizontal axis wind turbine - Vertical axis wind turbine - Rotor selection - Design considerations - Choice of power plant - Wind mapping and selection of location - Cost analysis and economics of systems utilizing renewable sources of energy.

Text Books

1. David Merick, Richard Marshall, (2001), Energy, Present and Future Options, Vol. I and II, John Wiley and sons.
2. Non-Conventional Energy Sources by *G.D Rai K*, Khanna Publishers, 2003.
3. Solar energy, by *Subhas P Sukhatme* – Tata McGraw Hill, 2nd Edition, 1996
4. Power Plant Engineering, Domakundawar, Dhanpath Rai sons. 2003
5. Power Plant Engineering, P. K. Nag Tata McGraw Hill 2nd edn 2001.

Reference books:

1. Renewable Energy Sources and Conversion Technology by N.K.Bansal, Manfred Kleeman & Mechael Meliss, Tata McGraw Hill, 2001.
2. Solar Power Engineering, P.K.Nag, Tata McGraw Hill, 2003.
3. Renewable Energy Resources, John.W.Twidell, Anthony. D. Weir, EC BG-2001.
4. Non-conventional resources, B H Khan TMH - 2007

MECHATRONICS & MICROPROCESSOR

Subject Code	BTME15F6620	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisite: Basic Electronics

Preamble

The subject of Mechatronics has often been described as a combination of the subjects of Electrical Engineering, Mechanical Engineering, Computer Engineering and Applied Control Engineering – in the union between these subjects the discipline of Mechatronics emerge. A typical Mechatronics system picks up signals from the environment processes them to generate output signals, transforming them for example into forces, motions and actions. It is the extension and the completion of mechanical systems with sensors and microcomputers which is the most important aspect. The fact that such a system picks up changes in its environment by sensors, and reacts to their signals using the appropriate information processing, makes it different from conventional methods.

Course Objectives:

- To understand elements of measurement systems and appreciate its relevance in engineering design
- To impart knowledge about working & performance of widely used sensors and actuators, electrical actuation systems.
- To gain knowledge of elements and programming techniques involved in microprocessors and microcontrollers which are essential to understand the emerging field of automation.

Course Outcomes:

After successful completion of the course, the students will be able to

- Understand the elements of microprocessor based controller systems
- Understand the working sensors and transducers
- Understand the different types of actuation systems
- Understand the basics, architecture and programming of microprocessor and microcontrollers

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BTME15F6620	CO1	2	2	1	-	-	-	-	-	1	-	-	-	2	2	2
	CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	1
	CO3	2	1	2	-	-	-	-	-	-	-	-	-	2	1	1
	CO4	2	2	-	-	-	-	-	-	1	-	-	-	2	1	1

Unit-1

Introduction: Measurement and control systems their elements and functions, Microprocessor based controllers, examples of mechatronic systems 6hrs

Transducers and Sensors: Static and dynamic characteristics of sensor, Potentiometers-LVDT-Capacitance sensor-Strain gauges-Eddy current sensor-Hall effect sensor-Temperature sensors-Light sensors. 7hrs

Unit-2

Actuation System: Electrical systems, Mechanical switches, solid-stat switches, solenoids, DC & AC motors, Stepper motors. 6hrs

Elements of mechanical actuation system. Introduction to programmable logic controllers. 5hrs

Unit-3

Introduction to microprocessors: Evolution of microprocessor, organization of microprocessor, basic concepts of programming of microprocessors. Boolean algebra, Logic gates & gate networks, Binary & Decimal number systems, memory representation of positive and negative integers, maximum and minimum integers. Conversion of real numbers, floating point notation, representation of floating point numbers, accuracy and range in floating point representation, overflow and underflow, addition of floating point numbers, character representation. 7 hrs

Logic functions: Data word representation, basic elements of control system, 8085A processor architecture, terminology-CPU, ALU, data registers, assembler, fetch cycle, bus, interrupts. Micro controllers and its classification, difference between microprocessors and microcontrollers. 6 hrs

Unit-4

Organization and programming of Microprocessors: Introduction of INTEL 8085-Data and Address buses, Instruction set of 8085, programming the 8085, assembly language programming. 6 hrs

Central Processing Unit of Microprocessors: Introduction, timing and control unit basic concepts, Instruction and data flow, system timing, examples of INTEL 8085 and INTEL 4004 register organization 5 hrs

Text Books:

1. **Mechatronics,** W.Bolton fourth edition, Pearson Publications, 2008.
2. **Microprocessor Architecture, Programming and applications with 8085/8086A,** R.S Ganokar, Wiley Eastern.

Reference Books:

1. **Mechatronics System Design,** Devdas shetty and Richard A. Kolk.
2. **Microprocessors and Microcontrollers,** Krishna Kant, Prentice Hall of India, 2007.

INDUSTRIAL ENGINEERING

Subject Code	BTME15F6630	IA Marks	25+25
Lecture-Tutorial-Practical/Week	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs./Week	3-0-0=3	Exam Marks	50

Prerequisite: Nill

Permeable:

In the present scenario the technology advancement plays a vital role in the manufacturing aspects which offers various advantages, which should be backed by management techniques in order to enhance the efficiency. The industrial engineering techniques such as work study, Method study, Work measurement and work sampling techniques which has impact in the production process in order to determine the standard time for the particular job, where these techniques gives the birds eye view's of the process which can be easily understandable of the concepts.

Course Objectives:

1. Fundamentals of Industrial Engineering, Application of Work study in the shop floor, Formulation of an LPP, Product Mix with respect to optimization.
2. To known the concepts of method study and work measurement with their relative technique.
3. To understand and learn the various application of industrial engineering techniques for the day to day process.
4. To determine the standard time for the specified job.

5. To know the various types of plant layout and its location in details.

Course Outcomes:

After successful completion of the course, the students will be able to

1. To apply the various techniques in order to analyze the production system with respects to industrial scenario.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
BTME15	**CO1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**

Unit-1: 6 Hrs

Introduction: Industrial Revolution and historic development of the factory system. Concept of Productivity, Various types of productivity, causes for lack of productivity and increase of work content. Production system and its types.

Plant location and layout:

Factors influencing plant location, theories of plant location, location economics, selection of specific site. Plant layout: Objectives of plant layout, principles of plant layout, types of plant layout, their merits and demerits, line balancing, Evaluation of Layouts. 6 Hrs

Unit -2

Work study and its techniques:

Definition of work study, Basic procedure of work study.

Method study: Introduction to method study, Definition, selection, recording, examining, developing, installing and maintaining new method. Use of recording techniques such as outline process , flow process chart, Two handed process chart, multiple activity chart, flow diagram , String diagram, Travel chart. Principles of motion economy, Micro motion study and simo chart. 6 Hrs

Work Measurement:

Definition, Common steps in work measurement, Time study method, breaking the task into work elements, types of elements, rating and different methods of rating. Allowances and its types. Calculation of basic time and standard time with numerical. 6 Hrs

Unit- 3

Work sampling:

Principles, Procedure, confidence limits, number of observations required, advantages and disadvantages, applications. Ergonomics: Human factors in the design of workplace, layout of equipment, design of displays and controls. Fatigue and measurement of fatigue. 6 Hrs

Material Handling: Principles of material handling, classification of material handling equipment, selection of material handling equipment in details. 6 Hrs

Unit-4

Equipment Replacement:

Nature of replacement problems, economic life of challenger and defender, Replacement of items – individual replacement and group replacement 6 Hrs

New forms of work organization

Design of individual work roles, Design of group work in production, Design of product oriented organization, flow patterns in product oriented organizations, Criteria for good work organization.

Depreciation – Definition, factors , Types of Depreciation with numerical . 6 Hrs

Text Books:

1. Introduction to Work study, ILO(International Labor organization)
2. Industrial Engineering and Economy , O.P.Khannan, PHI Publisher

Reference Books:

1. Hand book of Industrial Engineering , Maynard
2. Motion and time studyt, Ralph.M.Barnes, John wiley.
3. Motion and time study , Marvin.E.Mundel ,

EXPERIMENTAL STRESS ANALYSIS

Subject Code	BTME15F6640	IA Marks	25+25
Lecture-Tutorial-Practical (LTP)	3-0-0=3	Exam Hrs	3
Total No. of Contact Hrs. per Week	3-0-0=3	Exam Marks	50

Prerequisites: Basic Knowledge of Mechanics of materials, Design of machine elements and engineering physics.

Course Objectives:

1. To understand the relation between the mechanics theory and experimental stress analysis
2. To study the working principles of different types of strain gauges
3. To know the fundamentals of photo elastic coatings
4. To study the effects of 2-D photo elasticity
5. To be able to use the experimental techniques on the practical problems.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Students will demonstrate a basic understanding of experimental methods (e.g. strain gages, photo elasticity) commonly used in experimental solid mechanics.
2. Identify the different types of strain gauges
3. Apply the concepts of photo elastic coatings
4. Analyze the behavior of 2-D and 3-D photo elasticity

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
BTME15F6640	CO1	2	2	2	2	-	-	-	-	-	-	-	-	2	-	1
	CO2	2	3	2	2	1	-	-	-	-	-	-	-	-	2	-
	CO3	2	3	2	1	1	-	-	-	-	-	-	-	2	-	1
	CO4	2	2	1	1	1	-	-	-	-	-	-	-	-	1	-

UNIT-1 **12 Hours**

Electrical Resistance Strain Gages: Strain sensitivity in metallic alloys, Gage construction, Adhesives and mounting techniques, Gage sensitivity and gage factor, Performance Characteristics, Environmental effects, Strain Gage circuits. Potentiometer, Wheatstone's bridges, Constant current circuits.

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

UNIT-2 **12 Hours**

Photo-elasticity: Nature of light, Wave theory of light - optical interference , Stress optic law – effect of stressed model in plane and circular polariscopes, Isoclinics & Isochromatics, Fringe order determination Fringe multiplication techniques, Calibration photoelastic model materials**.**

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 photoelasticity

UNIT-3 12 **Hours**

Three Dimensional Photo elasticity: Stress freezing method, Scattered light photo-elasticity, Scattered light as an interior analyzer and polarizer, Scattered light polariscope and stress data Analyses.

Photoelastic (Birefringent) Coatings : Birefringence coating stresses, Effects of coating thickness: Reinforcing effects, Poisson's, Stress separation techniques: Oblique incidence, Strip coatings.

UNIT-4 12 **Hours**

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 ,0ut of plane displacement measurements, Out of plane slope measurements .Applications and advantages

TEXT BOOKS:

1. "Experimental Stress Analysis", Dally and Riley, McGraw Hill.
2. "Experimental Stress Analysis". Sadhu Singh, Khanna publisher.
3. Experimental stress Analysis, Srinath L.S tata McGraw Hill.

REFERENCES BOOKS:

1. "Photoelasticity Vol I and Vol II, M.M.Frocht, John Wiley &\ sons.
2. "Strain Gauge Primer", Perry and Lissner,
3. "Photo Elastic Stress Analysis", Kuske, Albrecht & Robertson John Wiley & Sons.
4. "Motion Measurement and Stress Analysis", Dave and Adams,

HEAT & MASS TRANSFER LAB

Subject Code	BTME15F6700	IA Marks	10+15=25
Lecture-Tutorial-Practical (LTP)	0-0-2=2	Exam Hrs	3
Total No. of Contact Hrs. per Week	0-0-2=2	Exam Marks	25

Prerequisite: Basic and Applied thermodynamics, Fluid mechanics

Course Objectives:

1. To learn the various modes of heat transfer
2. To know performance of the fins.
3. To understand the heat transfer by convection.
4. To learn the performance of the heat exchangers.
5. To study the unsteady heat transfer

Course Outcomes:

After successful completion of the course, the students will be able to

1. Define conduction, convection and radiation heat transfer.
2. Determine the heat transfer coefficient under various conditions.
3. Conduct the experiment to find the effectiveness of the fin.

4. Find out the radiation heat transfer properties.
5. Prepare the document of the experimental work conducted.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BTME 15F 6700	CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	2	3
	CO2	3	2	3	2	-	-	-	-	-	-	-	-	3	3	3
	CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	2	3
	CO4	3	1	3	2	-	-	-	-	-	-	-	-	3	3	3

PART – A

1. Determination of Thermal Conductivity of a Metal Rod.
2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
3. Determination of Effectiveness on a Metallic fin.
4. Determination of Heat Transfer Coefficient in a free Convection on a vertical tube.
5. Determination of Heat Transfer Coefficient in a Forced Convention Flow through a Pipe.
6. Determination of Emissivity of a Surface.

PART – B

1. Determination of Steffan Boltzman Constant.
2. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers
3. Experiments on Boiling of Liquid and Condensation of Vapour
4. Experiment on Transient Conduction Heat Transfer

COMPUTER AIDED MODELING AND ANALYSIS LABORATORY

Subject Code	BTME15F6800	IA Marks	10+15=25
Lecture-Tutorial-Practical (LTP)	0-0-2=2	Exam Hrs	3
Total No. of Contact Hrs. per Week	0-0-2=2	Exam Marks	25

Prerequisite: Finite element method

Preamble

FEA is gaining popularity day by day and is a sought after dream career for mechanical engineers. Enthusiastic engineers and managers who want to refresh or update the knowledge on FEA are encountered with volumes of published books. FEA is now a commonly used synonym for a wide range of computational techniques in engineering practice. All the engineering structures today; should be simulated for their performance on a computer compulsorily. This lab aims at teaching the basics of commercially available general purpose software for carrying out engineering analysis.

Course Objectives:

1. To provide sound knowledge of stress, displacement, deformation and load distribution of the beam.
2. To familiarize with the stress concentration factor.
3. To provide capability to analyze and solve practical problems based on the concept of principle of super position.
4. To analyze trusses problems & its application in the real world scenario.
5. Carryout dynamic analysis of Fixed – fixed beam for natural frequency and complex problems.

6. To carryout thermal analysis in order to determine the heat flux and temperature distribution of the domain.

Course Outcomes:

After successful completion of the course, the students will be able to

1. Apply the numerical methods for various applications of Mechanical Engineering
2. Analyze effect of stress concentration factor.
3. Analyze and solve practical problems of concept of stepped & tapered bar.
4. Analyze truss problems and provide solutions for the dynamic problems associated with various conditions
5. Determine natural frequency of fixed - fixed beam.
6. Prepare the document of the experimental work conducted

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15F6800	CO1	2	3	1	1	1	-	-	-	-	-	-	-	3	3	-
	CO2	2	3	1	1	1	-	-	-	-	-	-	-	2	2	-
	CO3	2	3	1	1	1	-	-	-	-	-	-	-	2	3	-
	CO4	2	3	1	1	1	-	-	-	-	-	-	-	3	2	-
	CO5	2	3	1	1	1	-	-	-	-	-	-	-	3	1	-
	CO6	2	3	1	1	1	-	-	-	-	-	-	-	2	1	-

PART – A

Study of a FEA package and modeling stress analysis of

a. Bars of constant cross section area, tapered cross section area and stepped bar 6 Hours

b. Trusses – (Minimum 2 exercises) 3 Hours

c. Beams – Simply supported, cantilever, beams with UDL, beams with varying load etc (Minimum 6 exercises) 12 Hours

PART – B

a) Stress analysis of a rectangular plate with a circular hole 3 Hours

b) Thermal Analysis – 1D & 2D problem with conduction and convection boundary conditions(Minimum 4 exercises) 9 Hours

c) Dynamic Analysis

1) Fixed – fixed beam for natural frequency determination

2) Bar subjected to forcing function

3) Fixed – fixed beam subjected to forcing function 9Hours

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7100	**Control Systems**	HC	2	1	0	3	4
Prerequisites: Laplace Transformation, Differentiation		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To understand the fundamentals related to automatic control, open and closed loop systems and feedback systems and their applications in real time.
2. Use of mathematical tool like Laplace transforms to analyze the system theoretically.
3. Representation of actual system in terms of physical model and mathematical model by writing mathematical equations.
4. To understand the behavior of the system for various inputs under time domain and frequency domain.
5. To analyze the performance and stability by using plots like polar plot, bode plot and root locus techniques.
6. Student has to understand the actual system and be able to analyze the system and give suitable solution.

Course Outcomes:

After Completion of the course the student will be able to

1. Able to understand practical aspects of automation needs of automation, field of automation.
2. Student can model the real time system into mathematical model which will helpful to design cost effective sophisticated device.
3. He may analyze the device in terms of mathematical model and test the model by using various techniques under time domain and frequency domain.
4. Able to use graphical techniques like Bode plot, Nyquist plot and root locus plot to check the stability of the model theoretically, after satisfaction of the result, the physical model can be developed and which will perform as per the requirement.
5. Through understanding of the subject will build the confidence to work in R&D Institutions or to become consultant.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7100	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	3	3
	CO2	3	3	3	1	-	-	-	-	-	-	-	-	1	2	3
	CO3	2	2	2	1	-	-	-	-	-	-	-	-	3	3	3
	CO4	3	3	3	1	2	-	-	-	-	-	-	-	3	2	3
	CO5	2	2	2	1	-	-	-	-	-	-	-	-	1	3	3

Course Content:

UNIT -1: **[12 hrs]**

Introduction: Concepts of automatic controls, Types of control systems, open and closed loop systems with examples, feedback system. Requirement of an ideal control system.

Mathematical Models: Models of mechanical systems, Transfer function, Numerical on mechanical system and transfer function, Block Diagrams: block representation of system elements, reduction of block diagrams.

UNIT -2: **[12 hrs]**

Signal flow Graphs: Mason's gain formula, numerical.
Time Response Analysis: Transient and Steady State Response Analysis: types of inputs, first order and second order system response to step, ramp and impulse inputs, (no derivation), time response specifications and concepts of time constant, numerical problems, System stability: Routh's-Hurwitz Criterion, numerical problems.

UNIT – 3: **[12 hrs]**
Frequency Response Analysis: Polar plots, Nyquist Stability Criterion, Stability Analysis, phase and gain margin, Stability Analysis using Bode plots, Simplified Bode Diagrams.

UNIT -4: **[12 hrs]**
Root Locus Plots: Definition of root loci, general rules for constructing root loci, Analysis using root locus plots.
Types of Controller & Compensation Techniques: proportional controller, differential controller, PI, PD & PID controllers, series, parallel, lead, lag, lead & lag compensation

Text Books:
1. K. Ogatta. **Modern Control Engineering** Pearson education, 2003
2. M.Gopal**, Control Systems principles & design** TMH, 2000

Reference Books
1. I.J.Nagarath & M.Gopal **Control Systems** New age International Publishers
2. Schaum's series **Feedback Control Systems** 2001

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7200	**Mechanical Vibrations**	HC	2	1	0	3	4
Prerequisites: Mathematics, Dynamics of machines		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To know the basics of vibration.
2. To study the un-damped and damped free vibration.
3. To study the forced vibrations.
4. To study the multi degrees of freedom system.
5. To study the vibration measuring instruments.

Course Outcomes:

After completion of the course the student will be able to
1. Write differential equation of the given vibration model.
2 Explain damping, natural frequency and resonance.
3. Write response of the vibrating system.
4. Define multi degrees of freedom systems.

5. Explain vibration measurement.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7200	CO1	3	1	1	-	-	-	-	-	-	-	-	-	3	2	1
	CO2	3	2	1	-	-	-	-	-	-	-	-	-	3	3	2
	CO3	3	2	2	2	-	2	1	-	-	-	-	-	3	1	3
	CO4	3	3	2	3	1	2	-	-	-	-	-	-	3	2	1
	CO5	3	1	1	-	-	-	-	-	-	-	-	-	2	3	2

Course Content:

UNIT – 1 [**12 hrs]**

Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Principle of super position applied to SHM, Beats, Fourier theorem and simple problems.

Undamped (Single Degree of Freedom) Free Vibrations: Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems.

UNIT – 2 [**12 hrs]**

Damped Free Vibrations (1-DOF): Types of damping**,** Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.

Forced Vibrations (1-DOF): Introduction**,** Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Problems.

UNIT-3 [**12 hrs]**

Vibration Measuring Instruments and Whirling of Shafts: Seismic Instruments – Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Whirling of shafts with and without damping, discussion of speeds above and below critical speeds ,Problems.

Systems with Two Degrees of Freedom: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, Undamped dynamic vibration absorber,Problems.

UNIT – 4 [**12 hrs]**

Numerical Methods for Multi Degree Freedom of Systems: Introduction, Maxwell's reciprocal theorem-Statement, Influence coefficients, Dunkerley's method, Stodola method, Holzer's method, Orthogonality of principal modes, method of matrix iteration, Problems.

Modal Analysis and Condition Monitoring: Machine maintenance techniques, condition monitoring and diagnosis, Signal analysis, dynamic testing of machines and structures, Experimental modal analysis.

Text Books:

1. S. S. Rao, **Mechanical Vibrations,** Pearson Education Inc, 4th edition, 2003.
2. V. P. Singh, **Mechanical Vibrations,** Dhanpat Rai & Company, 3rd edition, 2006.

Reference Books:

1. G. K.Grover, **Mechanical Vibrations,** Nem Chand and Bros, 6th edition, 1996.
2. W. T. Thomson, M. D. Dahleh and C. Padmanabhan, **Theory of Vibration with Applications,** Pearson Education Inc, 5th edition, 2008.

3. S. Graham Kelly, Schaum's outline Series, **Mechanical Vibrations:** Tata McGraw Hill, Special Indian Edition, 2007.
4. J. S. Rao & K. Gupta, **Theory and Practice of Mechanical Vibrations:** New Age International Publications, New Delhi, 2001.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7300	**Operation Research**	HC	4	0	0	4	4
Prerequisites: Mathematics		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To understand the fundamentals of OR, Formulation of an LPP.
2. To determine the optimal solution for a LPP Problem by using simplex, Big-M, Integer Programming, Duality.
3. Applications of LPP such as transportation problem , Assignment problem , travelling salesman problem in order to determine the minimum cost, maximum profit of transporting the commodity, assigning of jobs to machines and also to determine the minimum distance travelled by the salesman.
4. To analyze the waiting line model for real world applications.
5. To determine the project completion time by using PERT and CPM.
6. To know the scheduling of machines in the shop floor by using Johnson's algorithm.
7. To know the conflict between the two players in a game and also to identify the best strategy for the play.

Course Outcomes:

After completion of the course the students will be able to

1. Apply the various optimizing techniques in order to determine the optimal solution for the given real world problem in order maximize the profit or minimize the loss.
2. A Key tool for decision making of real world problems.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7300	CO1	2	3	3	-	-	-	-	-	-	-	-	-	3	2	3
	CO2	3	2	3	1	-	-	-	-	-	-	-	-	1	3	3

Course Content:

UNIT -1 **[12 hrs]**

Introduction to Operation Research: Definition, Scope of OR, OR models, Characteristics and phases

of OR. Advantages and limitation of OR. Mathematical formulation of LPP, Assumptions in LPP. Graphical solutions of LPP, Convex and non convex sets.

Linear Programming Problem: Slack, surplus and Artificial variables, Simplex method, Artificial Variable technique, BIG-M, , Concept of duality, Special cases such as unbounded solution, multiple optimal solution, infeasible solution &degeneracy

UNIT – 2 **[12 hrs]**

Transportation Problem: Formulation of transportation model, Determination of IBFS using different methods & optimality by modi(V-V) method. Balanced and unbalanced transportation Problem, Degeneracy in transportation problems and resolving degeneracy, maximization of transportation problem. Application of Transportation Problem: Assignment model – Hungarian Method, Formulation of the assignment model (Minimization and Maximization), Balanced and unbalanced model, special application problems on assignment model. Travelling salesman problem.

UNIT -3 **[12 hrs]**

Network Analysis – PERT & CPM Techniques. Project scheduling, Basic terminology used in project network, network construction, time estimates, determination of critical path and its durations, Floats , Variance under probabilistic models, prediction of project completion date, Concepts of cost in project and crashing of networks. Simple problem on crashing.

Waiting Line Model : Queue system and characteristics of queuing models, Kendall's notation, classification of the queue. The M/m/1 :∞/FCFS queuing system, Numerical problems

UNIT -4 **[12 hrs]**

Game Theory: Introduction, Definition, strategy, Formulation of games, pay off matrix, Maximin and minimax criteria, Saddle point, Types of games. Solution of game with and without saddle point, Graphical solution of 2 X n game & M X 2 game. Dominance property for rectangular game i.e., Mx N game. 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.

Text Books:

1. Prem kumar gupta and D.S.Hira, **Operations Research**, S.Chand Publication, New Delhi.
2. S.D.Sharma **Operations Research**, , Kedarnath ramanth & co.,

Reference Books:

1. Hiller and Liberman, **Introduction to Operation Research**, Tata McGraw hill.
2. Taha.H.A, **Operation Research and Introduction**, Pearson education edition.
3. Ravindran,**Operation Research: principles and practice**: Phillips and Solberg, wiley india ltd, 2nd edition 2007.
4. Kalavathy **Operation Research**, Vikas publications.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7410	**Cryogenic Engineering**	SC	3	0	0	3	3
Prerequisites: Refrigeration & Air-conditioning		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To introduce students to low temperature engineering and behavior of materials.

2. To develop students' skills to perform the analysis and design of cryogenic systems and cryo vessels.
3. To enable the students study the principles of cryogenic instrumentation.
4. To introduce students to cryogenic applications.

Course Outcomes:

After the completion of the course the Student will be able to

1. Define and identify the application of cryogenics.
2. Design cryogenic systems and cryo vessels.
3. Analyze the system.
4. Demonstrate the knowledge of cryogenic instrumentation

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7410	CO1	3	-		2	2	-	-	-	-	-	-	-	1	1	1
	CO2			3			-	-	-	-	-	-	-	2	-	-
	CO3		3				-	-	-	-	-	-	-	1	2	-
	CO4						-	-	-	3	3	-	-	2	3	3

Course content:

UNIT -1 Introduction to Low Temperature Engineering: [12 hrs]

Cryogenics – Principles of cryogenics – Methods of production of low temperature – Cryogenic fluids – Superconductivity and its applications – Super fluidity – Low temperature properties of structural materials – Applications of Cryogenics.

UNIT -2 Gas Liquefaction and Cryogenic Systems [12 hrs]

Liquefaction of gases – Linde Hampson system – Claude system – Heylandt system – Critical components of liquefiers,– Cryo coolers – Stirling Cryocooler – Gifford – McMahon cryo cooler – Pulse tube cryo cooler – Thermodynamic analysis of above systems.

UNIT -3 Gas Separation and Purification Systems [12 hrs]

Properties of mixtures – Principles of gas separation, Air, Hydrogen and Helium separation systems – Gas purification methods. Ultra low temperature refrigerators, magneto caloric refrigerator, 3He-4Hedilution refrigerator, Pomeranchuk cooling

UNIT -4 Storage and Transfer Systems [12 hrs]

Design of cryovessels – Concept of vapour coated shields – Cryogenic insulation – Vacuum, powder, multilayer insulation, Micro-sphere insulation. Cryogenic fluid transfer- transfer lines, pressurization, Transfer pump.

Cryogenic Instrumentation: Temperature, pressure, flow and level, measurement at low temperature – Cryostats – Cold electronics.

Text Book:

1. Randall F. Barron, **Cryogenic Systems**, (1999), Oxford University Press, New York.
2. Thomas M Flynn, **Cryogenic Systems**, Marcel Dekker, Inc N.Y. Basal 1997

Reference:

1. Haselden, G.G. **Cryogenic Fundamentals,** (1999), Academic Press Inc., London

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7420	**Product Design and Development**	SC	3	0	0	3	3
Prerequisites: None		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To demonstrate the awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
2. Ability to coordinate multiple, interdisciplinary tasks in. order to achieve a common objective

Course Outcomes:

After completion of this course, students will be able to:

1. Identify and analyze the product design and development processes in manufacturing industry.
2. Define the components and their functions of product design and development processes and their relationships from concept to customer over whole product lifecycle.
3. Analyze, evaluate and apply the methodologies for product design, development and management.
4. Undertake a methodical approach to the management of product development to satisfy customer needs.
5. Carry out cost and benefit analysis through various cost models.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7420	CO1						2	2	1	3	3	3	2	1	1	2
	CO2						1	2	1	3	3	3	2	2	2	2
	CO3						1	1	1	2	3	3	1	1	2	2
	CO4						1	1		3	3	3	1		1	1
	CO5	**3**	**2**	**2**	**1**	**1**						**1**		**2**	**3**	**1**

Course Content:

UNIT -1: Introduction to Product Design, & Processes [12 hrs]

Introduction: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development.

Development Processes and Organizations: A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

UNIT -2: Product Planning, Customer Needs and Product Specification: [12 hrs]

Product Planning: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.
Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.
Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications.

UNIT -3: Concept Generation, Selection and Testing: [12 hrs]

Concept Generation: The activity of concept generation clarifies the problem, search externally, search internally, explore systematically, reflect on the results and the process.
Concept Selection: Overview of methodology, concept screening, and concept scoring,
Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process.

UNIT -4: Product Design and Manufacturing [12 hrs]

Industrial Design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design.
Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.
Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes.

Text Books:

1. Karl.T.Ulrich, Steven D Eppinger - Irwin **Product Design and Development** Mc Graw Hill – 2000.
2. Sameul Eilon – **Elements of Production Planning and Control** – McMillan and Company,1962.
3. Jones S.W., **Product Design and Process Selection**, Butterworth Publications, 1973

Reference Books:

1. Harry Nystrom – **Creativity and Innovation**, John Wiley & Sons, 1979
2. George E. Dieter, Engineering Design – **Materials and Process Approach**, Tata McGraw-Hill,3rd Edition , 2000.
3. Donald E. Carter – **Concurrent Engineering**, Addison Wesley, 1992

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7430	**Engineering Economics and Financial Management**	SC	3	0	0	3	3
Prerequisites: None		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To understand principles and techniques of economic evaluation indifferent field of engineering
2. To know the assessment procedure for the financial position of an organization.
3. To understand meaning of internet, CFD, time value of the money**.**

Course Outcomes:

After completion of the course the student will be able to

1. Calculate NPV,NPW, EAW and compare and select best project.
2. Calculate EMI, internet and IRR to understand time value of the money.
3. Prepare budget, financial ratio's etc,.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
BTME15 F7430	CO1	3	3	1	-	-	-	-	-	-	-	-	-	3	2	3
	CO2	3	3	2	1	-	-	-	-	-	-	-	-	2	3	1
	CO3	3	2	3	1	-	-	-	-	-	-	-	-	3	1	2

Course Content:

UNIT– 1 **[12 hrs]**

Introduction: 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, Simple interest, Compound interest, Cash – flow diagrams, Personal loans and EMI Payment, Exercises and Discussion.

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, Pay-back comparison, Exercises, Discussions and problems.

UNIT – 2 **[12 hrs]**

Equivalent Annual-Worth Comparisons: Equivalent Annual-Worth Comparison methods, Situations for Equivalent Annual-Worth Comparisons, Consideration of asset life, Comparison of assets with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, Exercises, Problems.

Rate-of-Return Calculations and Depreciation: Rate of return, Minimum acceptable rate of return, IRR, IRR misconceptions, Cost of capital concepts. Causes of Depreciation, Basic methods of computing depreciation charges, Tax concepts, and corporate income tax.

UNIT-3 **[12 hrs]**

Estimating and Costing: Components of costs such as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads, First cost, Marginal cost, Selling price, Estimation for simple components.

Introduction, Scope of Finance, Finance Functions: Statements of Financial Information: Introduction, Source of financial information, Financial statements, Balance sheet, Profit and Loss account, relation between Balance sheet and Profit and Loss account. Simple Numerical

UNIT – 4 **[12 hrs]**

Financial Ratio Analysis: Introduction, Nature of ratio analysis, Liquidity ratios, Leverage ratios, Activity ratios, Profitability ratios, Evaluation of a firm's earning power. Simple numerical

Financial And Profit Planning: Introduction, Financial planning, Profit planning, Objectives of profit planning, Essentials of profit planning, Budget administration, type of budgets, preparation of budgets,

advantages, problems on flexible budget, cash budget and production budget. Introduction to Bench Marking of Manufacturing Operation.

Text Books:

1. Riggs J.L.,**Engineering Economy,** 4TH ed. , McGraw Hill, 2002
2. Thuesen H.G. **Engineering Economy,** PHI , 2002

Reference Books:

1. Tarachand, **Engineering Economy,** 2000.
2. O P Khanna, **Industrial Engineering and Management**, Dhanpat Rai & Sons. 2000
3. Prasanna Chandra, **Financial Management,** 7th Ed., TMH, 2004
4. IM PANDEY **Financial Management,** , Vikas Pub. House, 2002

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7440	**Theory of Plasticity**	SC	3	0	0	3	3
Prerequisites: Theory of Elasticity		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To known yield criteria for ductile metal.
2. To understand the plastic stress-strain relations.
3. To learn Upper and lower bound theorems and corollaries.
4. To solve Simple forms of indentation problems using upper bounds.

Course Outcomes:

After completion of the course the student will be able to

1. Demonstrate Idealized stress-strain diagrams for different material models
2. Demonstrate experimental verification of the Prandtl-Rouss equation
3. Solve Problems of metal forming

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7440	CO1	3	3	1	1	-	-	-	-	-	-	-	-	1	2	3
	CO2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	2
	CO3	3	3	1	1	-	-	-	-	-	-	-	-	2	1	2

Course Content:

UNIT – 1 **[12 hrs]**

Fundamental of Elasticity: Concept of stress, stress transformation laws, spherical and deviator stress tensors, equilibrium equations, octahedral stresses, concept of strain, deviator and spherical strain tensors,

strain transformation laws, octahedral strains, generalized Hooke's law, elastic strain energy, compatibility equations, theories of strength. Problems.

Plastic Deformation of Metals: Crystalline structure in metals, mechanism of plastic deformation, factors affecting plastic deformation, strain hardening, recovery, recrystallization and grain growth, flow figures or luder's cubes.

UNIT–2 **[12 hrs]**

Cubical Dilation, True Stress and Strain: Strain tensor, principal strain, plane strain, spherical and deviator strain, octahedral strain and representative strain, problems.

Stress Strain Relations: Introduction, types of materials, empirical equations, theories of plastic flow, experimental verification of St.Venant's theory of plastic flow, the concept of plastic potential, the maximum work hypothesis, mechanical work for deforming a plastic substance.

UNIT–3 **[12 hrs]**

Yield Criteria: Introduction, yield or plasticity conditions, Von Mises and Tresca criteria, Geometrical representation, yield surface, yield locus (two dimensional stress space), experimental evidence for yield criteria, energy required to change the shape with basic principle problems.

Slip Line Field Theory: Introduction, basic equations for incompressible two dimensional flow, continuity equations, stresses in conditions of plain strain, convention for slip lines, solutions of plastic deformation problem, Geometry of slip line field, Properties of the slip lines, construction of slip line nets

UNIT – 4 **[12 hrs]**

Bending of Beams: Analysis for stresses, Non linear stress strain curve, shear stress distribution, residual stresses in plastic bending, problems.

Torsion of Bars: Introduction, plastic torsion of a circular bar, elastic perfectly plastic material, elastic work hardening of material, residual stresses and problems

Text Books:

1. Chakraborty '**Theory of Plasticity',** 3rd Edition Elsevier.
2. W. Johnson and P. B. Mellor D Van **'Engineering Plasticity',** N.O Strand Co. Ltd 2000

Reference Books:

1. DWA Rees **Basic Engineering Plasticity,** 1st Edition Elsevier.
2. L. S. Srinath **Theory of Plasticity,** TMH,
3. Sadhu Singh, **Theory of Plasticity,** Kanna publisher

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7510	**Computational Fluid Dynamics**	SC	3	0	0	3	3
Prerequisites: Fluid Mechanics, Heat Transfer, Differential and Integral mathematics		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To provide the students with sufficient background to understand the mathematical representation of the governing equations of fluid flow and heat transfer.
2. To enable the students to solve one and two-dimensional ordinary and partial differential equations using traditional CFD tools.
3. To help the students solve fluid flow field using some popular CFD techniques.

Course Outcome:

After completion of the course the student will be able to

1. Possess the knowledge of CFD techniques, basic aspects of discretization and grid generation.
2. Solve fluid flow fields using CFD methods.
3. Model fluid flow problems and heat transfer.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7510	CO1	3	2	-	1	2	-	-	-	-	-	-	-	2	2	-
	CO2	3	2	1	-	1	-	-	-	-	-	-	-	2	3	1
	CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	2	1

Course Content:

UNIT -1 Introduction and Governing Equations [12 hrs]

Introduction - Impact and applications of CFD in diverse fields - Governing equations of fluid dynamics – Continuity - Momentum and energy - Generic differential form for governing equations - Initial and Boundary conditions - Governing equations for boundry layers -Classification of partial differential equations – Hyperbolic - Parabolic - Elliptic and Mixed types - Applications and relevance.

UNIT -2 Discretization [12 hrs]

Basic aspects of discretization - Discretization techniques – Finite difference - Finite volume and Finite Element Method– Comparison of discretization by the three methods - Introduction to Finite differences three-dimensional conduction in Cartesian coordinates – Explicit - Implicit - Crank-Nicolson - ADI scheme – Stability criterion. Difference equations - Numerical errors -.truncation errors, round off error.

UNIT -3 CFD Tool [12 hrs]

Geometry-meshing-grid independent test, mesh refinement analysis, validation, results. Turbulent modeling, convergence, accuracy. Examples.

UNIT -4 Advance CFD:

[12 hrs]

Introduction, large eddy simulation, direct numerical simulation, multi flow combustion, case study, future in CFD.

Text Books

1. J.D. Anderson, Jr., (2000), **Computational Fluid Dynamics – The basics with applications**, McGraw-Hill, Incs.

Reference Books

1. K. Muralidhar, T. Sundarajan, (2001), **Computational Fluid Flow and Heat Transfer**, Narosa Publishing House, New Delhi.
2. S.V. Patankar, (1999), **Numerical Heat Transfer and Fluid Flow**,
3. Jiyuan Tu **Computational fluid Dynamics – A practical approach**-Elsevier publication

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7520	**Nano Technology and Applications**	SC	3	0	0	3	3
Prerequisites: Material Science		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To enable the students understand the basic concepts of Nanotechnology
2. To enhance the knowledge of students in nano materials
3. To familiarize the students with the properties of nano materials and their applications
4. To expose the students MEMS / NEMS devices and their applications

Course Outcomes:

After completion of the course the student will be able to

1. Student will be able to . Use Nano materials for various industrial applications
2. Design MEMS / NEMS devices for various applications .
3. Demonstrate the knowledge of devices used in MEMS/NEMS

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7520	CO1	3	3	2	-	1	1	1	-	-	2		2	1	1	3
	CO2	1	2	3	-	-	-	-	-	-	-	-	-	2	2	2
	CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	1	2

Course Content:

UNIT-1: Introduction to Nano Science & Technology: [12 hrs]

Single crystal, polycrystal and a nanocrystal- Nano in nature- Significance of nanostructures-- Present and future applications of nanomaterials - Classification of nanomaterials - magic numbers-Electronic and structural magic numbers - bulk to nanotransition- Size dependent property changes- Factors leading to changes-Surface to volume ratio and quantum confinement -stabilization of nanoparticles.

UNIT -2: Synthesis, Characterization of Nano Materials and Mechanical Properties: [12 hrs]

Bottom-up and top down approaches- Inert gas condensation- Ball milling and Sol –gel - lithographic techniques- Particle size determination- XRD- laser diffraction- SEM,TEM, Raman ,Infrared spectroscopies , AFM and contact angle measurement and porosimeter –phase transitions in nano systems- Inverse-Hall-Petch behaviour–mechanical properties of nanomaterials.

UNIT -3: Applications of Nano Materials in Automobiles, Aerospace, Energy and Biomedical areas [12 hrs]

Metallic nanoparticles, Cu, Ag ,Au, Pd, Rh ,Modulus and hardness, melting point depression , catalytic, antifungal and anti bacterial properties, chemical sensors ,CeO2- fuel efficiency – magnetic nanoparticles - s Metallic nanoparticles, Cu, Ag, Au, Pd, Rh ,Modulus and hardness, melting point depression , catalytic, antifungal and anti bacterial properties, chemical sensors ,CeO2- fuel efficiency – magnetic nanoparticles

UNIT -4 : Nano Machines and Nano Devices: [12 hrs]

Microelecrtoromechanical systems- (MEMS) –Nanoelectromechanical systems (NEMS), Fabrication-nanodevices and nanomachines , molecular and supramolecular switches . Nano tribology

Text Books

1. Charles P. Poole, Frank J. Owens, (2000), **Introduction to Nanotechnology**, John Wiley & Sons.
2. C.N.R.Rao, P.J.Thomas and U.Kulkarni, **Nanomaterials:Synthesis, properties and applications** Springer-Verlag (2007)

Reference Books

1. Glieter, **Nanocrystalline Materials**, Progress in Materials Science Vol. 33, pp. 223-315, 1989
2. C. Suryanarayana, **Mechanical Alloying and Milling**, Progress in Materials Science 46 (2001) 1,184

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7530	**Tribology and Bearing Design**	SC	3	0	0	3	3
Prerequisites: Fluid Mechanics		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To provide broad based understanding of the interdisciplinary subject ‘tribology’ and its technological significance
2. To understand the nature of engineering surfaces, their topography and learn about surface characterization techniques.
3. To learn about the contact of solid surfaces and their interactions
4. To understand the genesis of friction, laws of sliding and rolling friction
5. To learn about consequences of wear, wear mechanisms, wear theories and analysis of wear problems
6. To learn about the principles of lubrication, lubrication regimes, theories of hydrodynamic, elasto hydrodynamic and mixed/ boundary lubrication

7. To learn about tribo testing and experimental techniques in tribology

8. To learn about tribology of different machine components

Course Outcomes:

After completion of the course the student will be able to

1. Demonstrate basic understanding of friction, lubrication, and wear processes.
2. Use mathematical tools to analyze tribological processes.
3. Become familiar with common anti-friction and anti-wear components and the lubricants used therein.
4. Describe the detailed operation of selected anti-friction or anti-wear components
5. Design a tribological system for optimal performance.
6. Develop technical project reports and technical presentations

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7530	CO1	3	3	1	1	-	-	-	-	-	-	-	-	1	2	2
	CO2	3	3	2	1	-	1	-	-	-	-	-	-	2	1	2
	CO3	3	3	2	2	-	1	-	-	-	-	-	-	1	2	1
	CO4	2	3	2	1	-	-	1	-	-	-	-	-	3	1	2
	CO5	3	3	2	2	-	1	-	-	-	-	-	-	2	1	2
	CO6	2	3	2	1	-	-	1	-	-	-	-	-	2	2	1

Course Content:

UNIT – 1 Introduction to Tribology: [12 hrs]

Properties of oils and equation of flow: Viscosity, Newton's Law of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, classification of lubricants.

Hydrodynamic Lubrication: Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, mechanism of pressure development in an oil film, Reynold's investigation and Reynold's equation in 2D.

UNIT – 2 Idealized Journal Bearing: [12 hrs]

Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's numbers and significance of it; Partial bearings, end leakages in journal bearing, numerical problems.

Slider / Pad Bearing With A Fixed And Pivoted Shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, numerical examples.

UNIT – 3 Oil Flow and Thermal Equilibrium of Journal Bearing: [12 hrs]

Oil flow through bearings, self-contained journal bearings, bearings lubricated under pressure, thermal equilibrium of journal bearings.

Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.

UNIT - 4 Bearing Materials: **[12 hrs]**

Commonly used bearings materials, properties of typical bearing materials. Advantages and disadvantages of bearing materials.

Behavior Of Tribological Components: Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. Tribological measures, Material selection, improved design, surface engineering.

Text Books

1. Basu S K., Sengupta A N., Ahuja B. B., **Fundamentals of Tribology** , , PHI 2006
2. Mujumdar B. C., **Introduction to Tribology Bearings,** S. Chand company pvt. Ltd 2008.

Reference Books

1. Fuller, D., **Theory and Practice of Lubrication for Engineers,** New York company 1998
2. Moore,**Principles and Applications of Tribology,** Pergamaon press 1998
3. Srivastava S., **Tribology in Industries,** S Chand and Company limited, Delhi 2002
4. Redzimovskay E I., **Lubrication of bearings – Theoretical Principles and Design,** Oxford press company 2000

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7540	**Automation In Manufacturing**	SC	3	0	0	3	3
Prerequisites: Manufacturing science and CIM		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. The aim of the course is to define the concept of automation and building blocks, Fundamentals of manufacturing.
2. To specify the components of automated production, group technology and cellular manufacturing concept.
3. To explain the types of transfer mechanism that may be used for work part transfer.
4. To outline how storage buffers can be deployed in automated production line
5. To explain the concept of automated assembly system.
6. To enable a student of course from industry to develop new methodologies for
7. Application in industry.

Course Outcomes:

After completion of the course the student will be able to

1. Evaluate the product and production relationships.
2. Understand the cost of manufacturing operations.
3. Involve in the design of transfer mechanisms that may be need for work part transfer in manufacturing sector.
4. Evaluate the utilization and availability of the infrastructure in the automated production line (APL).
5. understand the new automation technologies like Group Technology (GT), Bar code systems, Lean manufacturing, JIT, Agile manufacturing.
6. Implement the concept of Line balancing.
7. Understand the modern automated industries requirements.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7540	CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2
	CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2
	CO3	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
	CO4	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
	CO5	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
	CO6	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
	CO7	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2

Course Content:

UNIT – 1 **[12 hrs]**

Introduction: Production System Facilities, Automation definition, type and reason, Manuel labour in production system, product and production relationship, cost of manufacturing operation.

Industrial Control System: Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control.

UNIT – 2 **[12 hrs]**

Material Handling: Overview, principle, material transportation system and storage system

Automated Manufacturing Systems: Components of a Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells.

UNIT – 3 **[12 hrs]**

Group Technology & Flexible Manufacturing Systems: Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning & Implementation Issues.

Quality Control Systems: Traditional and Modern Quality Control Methods, Taguchi Methods in Quality Engineering. Introduction to SQC Tools.

UNIT – 4 **[12 hrs]**

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 Techniques & Non-contact Non-optical Inspection Technologies

Manufacturing Support System: Process Planning, Computer Aided Process Planning, Concurrent Engineering & Design for Manufacturing, Advanced Manufacturing Planning, Just-in Time Production System, Basic concepts of lean and Agile manufacturing.

Text Books

1. M. P. Groover, **Automation, Production Systems and Computer Integrated Manufacturing,** Pearson education. Third Edition, 2008
2. Vajpayee **Principles of CIM,** , PHI.

Reference Books

1. Amber G.H & P. S. Amber, **Anatomy of Automation**, Prentice Hall.
2. Viswanandham, **Performance Modeling of Automated Manufacturing Systems,** PHI
3. Krishna Kant, **Computer Based Industrial Control**, EEE-PHI

OPEN ELECTIVE
(FOR STUDENTS OF OTHER SCHOOLS)

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7610	**Industrial Automation and Production Systems**	OE	4	0	0	4	4
Prerequisites: None		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. The aim of the course is to define the concept of automation and building blocks, fundamentals of manufacturing.
2. To specify the components of automated production, group technology and cellular manufacturing concept.
3. To explain the types of transfer mechanism that may be used for work part transfer.
4. To outline how storage buffers can be deployed in automated production line
5. To explain the concept of automated assembly system.
6. To enable a student of course from industry to develop new methodologies for application in industry.

Course Outcomes:

After completion of the course the student will be able to

1. Evaluate the product and production relationships.
2. Understand the cost of manufacturing operations.

3. Involve in the design of transfer mechanisms that may be need for work part transfer in manufacturing sector.
4. Evaluate the utilization and availability of the infrastructure in the automated production line (APL).
5. Understand the new automation technologies like Group Technology (GT), Bar code systems, Lean manufacturing, JIT, Agile manufacturing.
6. Implement the concept of Line balancing.
7. Understand the modern automated industries requirements.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7610	CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2
	CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2
	CO3	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
	CO4	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
	CO5	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
	CO6	3	1	-	-	-	-	-	-	-	-	-	-	1	1	1
	CO7	3	2	-	-	-	-	-	-	-	-	-	-	2	2	2

Course Content:

UNIT-1 [**12 hrs]**

Introduction: Automation, Production System Facilities, Manufacturing Support systems, Automation in Production systems, Reasons for automating, Automation principles, Ten Strategies, Migration Strategies.
Manufacturing Operations: Product/Production Relationship, Production concepts and Mathematical Models, Costs of Manufacturing Operations, Problems.

UNIT-2 [**12 hrs]**

Industrial Control Systems: Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automation, Continuous versus Discrete control.
Material Handling and Identification Techniques: Industrial trucks, Automated guided vehicle systems, Monorails and other rail guided vehicles, Conveyor systems, Cranes and hoists, Automated storage systems, Bar code technology.

UNIT-3 [**12 hrs]**

Group Technology & Flexible Manufacturing Systems: Part Families, Parts Classification and coding, Production Flow Analysis, FMS, FMS Components, FMS Applications & Benefits, FMS Planning & Implementation Issues.
Quality Control Systems: Traditional and Modern Quality Control Methods, Taguchi Methods in Quality Engineering, Introduction to SQC, SQC Tools.

UNIT-4 [**12 hrs]**

Inspection Technologies: Automated Inspection, Coordinate Measuring Machines Construction (CMM), operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection

Probes on Machine Tools, Machine Vision, and Optical Inspection Techniques & Noncontact Non-optical Inspection Technologies.

Manufacturing Support System: Process Planning, Computer Aided Process Planning(CAPP), Concurrent Engineering (CE), Design for Manufacturing (DFM), Just-in Time Production System (JIT), Basic concepts of lean and Agile manufacturing, Comparisons of Lean & Agile Manufacturing.

Text Books:

1. M. P. Groover, **Automation, Production Systems and Computer Integrated Manufacturing**, Pearson education. Third Edition, 2008
2. Vajpayee, **Principles of CIM**, PHI.

Reference Books:

1. Amber G.H & P. S. Amber, **Anatomy of Automation**, Prentice Hall.
2. Viswanandham, **Performance Modeling of Automated Manufacturing Systems**, PHI
3. Krishna Kant, **Computer Based Industrial Control**, EEE-PHI

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7620	**Industrial Engineering**	OE	4	0	0	4	4
Prerequisites: None		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. Fundamentals of Industrial Engineering, Application of Work study in the shop floor.
2. To know the concepts of method study and work measurement with their relative technique.
3. To understand and learn the various application of industrial engineering techniques for the day to day process.
4. To determine the standard time for the specified job.
5. To access the value for a particular product
6. To know about the depreciation and equipment replacements concepts in detail.

Course Outcomes:

After completion of the course the students will be able to

1. Apply the various techniques in order to analyze the production system with respects to industrial scenario.
2. Take right decisions to optimize the resource utilization by improving productivity of the lands, buildings, peoples, materials, machines, money, methods and management effectively.
3. Eliminate unproductive activities under the control of management, supervisor, worker and design of the products and processes.
4. Use the charts to record the activities of the people, materials and equipment to find alternate methods which minimize the waste and implement the best method.

5. Improve processes by applying various IE techniques and find the standard time.
6. Design man machine system to improve human efficiency and reduce the effort of the workers.
7. Apply various method of depreciation and replacement of equipment based on the cost with respect to individual or group policy.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F7620	CO1	3	3	2	-	-	-	-	-	-	-	-	-	2	3	2
	CO2	3	3	2	-	-	-	-	-	-	-	-	-	1	1	2
	CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	2	2
	CO4	3	3	2	-	-	-	-	-	-	-	-	-	2	3	2
	CO5	3	3	2	-	-	-	-	-	-	-	-	-	3	2	2
	CO6	3	3	3	-	-	-	-	-	-	-	-	-	2	3	2
	CO7	3	3	2	-	-	-	-	-	-	-	-	-	1	2	2

Course Content:

UNIT-1: [**12 hrs]**

Introduction: Industrial Revolution and historic development of the factory system. Productivity and its index, effectiveness and efficiency, various types of productivity, partial, total factor and total productivity, productivity cycle, productivity improvement techniques Production system and its types.

Plant Location and Layout: Factors influencing plant location, location economics, selection of specific site. Plant layout: Objectives of plant layout, principles of plant layout, types of plant layout, their merits and demerits, Evaluation of Layouts.

UNIT-2 [**12 hrs]**

Work Study and its Techniques: Definition of work study and method study, Basic procedure of work study and method study. Use of recording techniques such as outline process , flow process chart, Two handed process chart, multiple activity chart, man-machine chart.

Work Measurement: Definition, Common steps in work measurement, Time study method, breaking the task into work elements, types of elements, rating and different methods of rating. Allowances and its types. Calculation of basic time and standard time with numerical.

UNIT-3 [**12 hrs]**

Work Sampling: Principles, Procedure, confidence limits, number of observations required, advantages and disadvantages, applications. Ergonomics: Human factors in the design of workplace, layout of equipment, design of displays and controls.

Quality and Value Engineering: Quality definition, quality attributes,7QC tools, quality costs, ISO certification process and its benefits. Value engineering- definition , kinds of value, key elements, value engineering job plan, life cycle cost and product life cycle.

UNIT-4 [**12 hrs]**

Depreciation – Definition, factors, Types and methods of Depreciation with numerical.

Equipment Replacement: Nature of replacement problems, economic life of challenger and defender, Replacement of items – individual replacement and group replacement

Text Books:

1. ILO(International Labor organization) **Introduction to Work study**,
2. O.P.Khanna, **Industrial Engineering and Economy** , PHI Publisher

Reference Books:

1. Maynard **Hand book of Industrial Engineering** ,
2. Ralph.M.Barnes, **Motion and Time Study**, John Wiley.
3. Marvin.E.Mundel **Motion and Time Study** , ,

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7700	**CIM and Automation Lab**	HC	0	0	2	2	3

Prerequisites: Manufacturing Technology CAD/CAM/CIM	Internal Assessment	Semester End Exam
	20 Marks	30 Marks

Course Objectives:

1. To train the students with part programming concepts
2. Generation of manual part programming – CNC Turn and CNC mill
3. Generation of tool path and NC part program by using part Geometry.

Course Outcomes:

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

1. Generate the part program for the given profile/part geometry – offline
2. Able to work on CNC machines.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BTME15 F7700	CO1	3	2	-	-	3	-	-	-	-	-	-	-	3	3	1
	CO2	3	2	-	-	3	-	-	-	-	-	-	-	2	2	3

Course Content:

CNC, Part Programming using CAM packages simulation of Turning, Drilling and milling operations. Simulations to be carried out using simulation packages like Master CAM, Edge CAM, Cadem , MTAB or any equivalent software. (Model should consist of Minimum 4 operations).

DEMO of Flexible Manufacturing system, ASRS, AGVS Robot Programming, Hydraulic and pneumatic, basics of these topics to be conducted.
Reference: Manual prepared by REVA University Faculty.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F7800	**Design Lab**	HC	0	0	2	2	3

Prerequisites: Theory of Machines and Vibration	Internal Assessment	Semester End Exam
	20 Marks	30 Marks

Course Objectives:

1. To learn the testing procedure in design field.
2. To know the frequency of the rotating objects
3. To know the stress and strain in the component when it undergoes various types of loads.
4. To understand the stress concentration in the elements.
5. To learn the use of strain gages and its working principle

Course Outcomes:

After completion of the course the student will be able to

1. Define frequency, critical speed and terminologies used in the dynamics of the machines.
2. Determine the stress and strain in the component.
3. Analyze the governors.
4. Define stress concentration and its importance and determine the stress concentration factor.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BTME15 F7800	CO1	3	2	2	2	1	2	-	-	-	-	-	-	2	3	3
	CO2	3	1	1	2	1	2	-	-	-	-	-	-	3	2	3
	CO3	3	1	2	2	1	2	-	-	-	-	-	-	2	3	3
	CO4	3	1	2	2	1	2	-	-	-	-	-	-	2	3	3

Course Content:

PART – A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Determination of critical speed of a rotating shaft.
3. Determination of Fringe constant of Photo elastic material using.
    a) Circular disc subjected to diametrical compression.

b) Pure bending specimen (four point bending)

4. Balancing of rotating masses.
5. Determination of Principal Stresses and strains in a member subjected to combined Loading using Strain rosettes.
6. Determination of pressure distribution in journal bearings
7. Determination of equilibrium speed, sensitiveness , power and effort of porter governor
8. Experiment on Gyroscope (demonstration only)

PART – B

1. Introduction to MATLAB- Capabilities, Commands and creating m-files.
2. Variations of the natural frequency and the time period with static deflection of an undamped system.
3. Free-Vibration Response of a Spring-Mass System.
4. Unforced Response Spring Mass Damper System.
5. Simulation of Simple Pendulum.
6. Simulation of Three Bar Linkage Mechanism.

EIGHTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8100	**Safety Measures in Mechanical Engineering**	HC	3	0	0	3	3
Prerequisites: Basic knowledge on manufacturing process and Machines		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To know the reasons for accidents happen in mechanical Industries
2. To understand the safety procedure to avoid accidents
3. To know the safety rules and regulations.
4. To understand the various acts of Govt of India.
5. To know the responsibility as a citizen, employer, employee and head of the family

Course Outcomes:

After completion of the course the student will be able to

1. Define various reasons for industrial accidents.
2. Predict type of accident may occur.
3. Use various safety rules during the work.
4. Act as a responsible person.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F8100	CO1	2	1	1	-	-	3	2	1	-	-	-	-	2	-	2
	CO2	2	1	1	-	-	1	1	-	-	-	-	-	2	-	2
	CO3	2	1	1	-	-	3	1	-	-	-	-	-	2	-	2
	CO4	2	1	1	-	-	1	1	-	-	-	-	-	2	-	2

Course Content:

UNIT-1 Accidents & Safety [12 hrs]

Definitions and theories.- Accident - Injury - Unsafe act - Unsafe condition -Dangerous occurrence - Theories and principles of accident causation - Cost of accidents - Accident reporting and investigations - Safety committees - Need - Types- Advantages. Safety education and training - Importance - Various training methods -Accident prevention - Motivating factors - Safety suggestion schemes. Safety performance - Definitions connected with measuring safety performance as per Indian and International standards.

UNIT- 2 Safety in Mechanical Handling [12 hrs]

General safety consideration in material handling - Ropes, Chains, Sling, Hoops, Clamps, arresting gears - Prime movers. Ergonomic consideration in material handling, design, installation, operation and maintenance of conveying equipments, hoisting, traveling and slewing mechanisms. Selection, operation and maintenance of industrial trucks - Mobile cranes - Tower crane.

UNIT-3 Safety in Storage & Handling of Chemicals and Gases [12 hrs]

Safety in the design process of chemical plants - Safety in operational and maintenance - Exposure of personnel - Operational activities and hazards - Safety in storage and handling of chemicals and gases - Hazards during transportation - Pipeline transport - Safety in chemical laboratories. Specific safety consideration for cement, paper, pharmaceutical, petroleum, petro - chemical, rubber, fertilizer and distilleries.

UNIT-4 Regulations for Health, Safety and Environment [12 hrs]

Factories act and rules; - Indian explosive act - Gas cylinder rules – Environmental pollution act - Indian petroleum act and rules - Oil industry safety directorate (OISD) - Indian Electricity act and rules. - Mines act and rules - Indian motor vehicles act and rules.

Text Books

1. Handlin.W**, "Industrial Hand Book",** McGraw-Hill, 2000.
2. Anton.T.J, **"Occupational safety and health management",** (2nd Edition). New York, McGraw Hill, 1989.

Reference Books

1. Heinrich.H.W, **"Industrial Accident Prevention***",* McGraw-Hill, 1980.
2. Rudenko.N, **"Material Handling Equipments",** Mir Publishers, Moscow, 1981.

3. Lees.F.P, **"Loss "Prevention in Process Industries",** Butterworths, NewDelhi,1986.
4 **IS CODES of Oil Industry Safety Directorate**, Govt. of India.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8210	**Automotive Engineering**	SC	3	0	0	3	3
Prerequisites: IC Engines		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To broaden the understanding of students in the structure of vehicle chassis and engines.
2. To introduce students to steering, suspension, braking and transmission systems.
3. To introduce students to engine auxiliary systems like heating, ventilation and air-conditioning.
4. To teach students about the importance of alternate fuels and modifying the engine suitably.

Course Outcomes:

After completion of the course the student will be able to

1. Develop chassis and identify suitable engine for different applications
2. Formulate steering, braking and suspension systems
3. Select a suitable conventional and automatic transmission system

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BTME15 F8210	CO1	3	2	-	-	-	-	-	-	-	1	-	-	3	1	-
	CO2	2	2	-	-	-	-	-	-	-	1	-	-	2	2	-
	CO3	2	2	-	-	-	-	2	-	-	-	-	-	2	2	1

Course Content:

UNIT–1 **[12 hrs]**

Engine Components: Basic components of engine components, importance with reference to application valve timing diagrams for SI engine and CI engine, Types of combustion chambers for S.I. Engine and C.I. Engines, methods of a Swirl generation, engine positioning, cooling requirements, methods of cooling and lubrication.

Fuels, Fuel Supply Systems For Si Engines: Conventional fuels, alternative fuels, Combustion in S I and C I engines, normal and abnormal combustion, Knocking and detonation, cetane and octane numbers, Fuel mixture requirements for SI engines,

UNIT–2 **[12 hrs]**

Fuel Supply System:- Carburetor-construction and working of simple carburetor, multi point and single point fuel injection systems. Fuel transfer pumps, Fuel filters, fuel injection pumps and injectors. Fuel injection system in CI engines, CRDI System.

Superchargers And Turbochargers: Naturally aspirated engines, Forced Induction, Types of superchargers, Turbocharger construction and operation, Intercooler.

Ignition Systems: Battery Ignition systems, magneto Ignition system,. Electronic Ignition system, Ignition advance.

UNIT–3 **[12 hrs]**

Power Trains: General arrangement of clutch, Principle of friction clutches, Fluid flywheel, Single plate, multi-plate and centrifugal clutches.

Gear Box: Necessity for gear ratios in transmission, synchromesh gear boxes, 3, 4 and 5 speed gear boxes. Free wheeling mechanism, planetary gears systems, over drives, fluid coupling and torque converters, Epicyclic gear box, principle of automatic transmission,

Drive To Wheels: Propeller shaft and universal joints, Hotchkiss and torque tube drives, differential, rear axle, different arrangements of fixing the wheels to rear axle, steering geometry, camber, king pin inclination, included angle, castor, toe in & toe out, steering gears, power steering, general arrangements of links and stub axle, over steer, under steer and neutral steer.

UNIT–4 **[12 hrs]**

Suspension System and Brakes: Requirements, Torsion bar suspension systems, leaf spring, coil spring, independent suspension for front wheel and rear wheel. Air suspension system.

Brakes:- Brakes and its mechanism, Disk brakes, drum brakes, Antilock –Braking systems, purpose and operation of antilock-braking system, ABS Hydraulic Unit.

Engine Emissions and Standards:- S I Engine emissions and C I Engine emissions, emission controls, Controlling the air-fuel mixture, Controlling the combustion process, Cleaning the exhaust gas, Exhaust gas recirculation, Catalytic converter, Brief discussion on Emission standards- Euro I, II, III and IV norms, Bharat Stage II, III and IV norms.

Text Books

1. William.H.Crouse, (2006), **Automotive Mechanics**, 10th Edition, McGraw-Hill.
2. Kirpal Singh, **Automobile Engineering**, Vol.1&2, Standard Publications.
3. Mathur and Sharma **Automobile Engg**

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8220	**Robotics**	SC	3	0	0	3	3
Prerequisites: Matrices, Theory of Machines		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. Learn the concepts of robot representation using concepts of kinematics & mathematics.
2. Learn & understand the uses & limitation of robotic & vision applications.
3. Learn basic methods & algorithms of path planning for mobile robots.
4. Learn robot transformation.

Course Outcomes:

After completion of the course the students will be able to

1. Understand the position and orientation of the object in space in a 3 dimensional space.
2. Understand the relationship between joint variables and the position and orientation of the robot end effectors
3. Plan the trajectories for the robot end effectors to perform specific task
4. Understand the basic principle of image acquisition & image components.
5. Apply the knowledge to design actual robots to perform basic operations such as pick & place line follower robots etc.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BTME15 F8220	CO1	2	2	2	2	-	-	-	-	-			2	3	3	2
	CO2	2	1	2	2	-	-	-	-	1	-	-	-	3	3	2
	CO3	3	2	1	2	-	-	-	-	-	-	-	-	3	3	2
	CO4	3	2	1	2	-	-	-	-	-	-	-	-	3	3	2
	CO5	3	2	2	1	-	-	-	-	-	-	-	-	1	2	2

Course Content:

UNIT-1 **[12hrs]**

Robotics – history, definition and anatomy of robot, Introduction–Basic Structure– Classification of

robot and Robotic configuration –laws of robotics – robot motions – work space, precision of movement. Types of joints : Rotary, prismatic, cylindrical & spherical joints, resolution, repeatability and accuracy of robot. Position & orientation of rigid body, universal frames & fixed frames, Euler angle representation for xyz, zyz frames.

UNIT-2 Kinematics of Robots **[12 hrs]**

Mathematical representation of Robots, Kinematics of Robot : Introduction, Matrix Representation, Homogeneous transformation, forward and inverse Kinematics, Inverse Kinematics Programming, Degeneracy, dexteritying, transformation matrix for 2R and 3R manipulator, puma 560 & SCARA manipulator and standford.

UNIT-3 Trajectory Planning and Applications **[12 hrs]**

Trajectory planning & avoidance of obstacles uninformed path search, informed path search, A* & B* algorithms, bus algorithms with tactile sensors & case studies.

End Effectors:- mechanical gripper, types, hydraulic, pneumatic and electric actuators used in robot.

Robot Applications: Industrial and non industrial application, mobile application, limitations and future application of robot.

UNIT-4 **[12 hrs]**

Machine Vision systems : Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization – Image definition, levels of Computation.

Programming of Robots: Types of programming, on line and off line programming, types- manual and led through programming, programming languages, VAL and its commands, storing and operating, point to point tasks.

Text Book:

1. Saeed B. Niku, **Introduction to Robotics: Analysis, Systems, Applications**, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)

References Book:

1. M.P. Groover, **Industrial Robotics – Technology, Programming and Applications**, McGraw-Hill, USA, 1986.
2. Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, **Machine Vision**, Tata McGraw-Hill, 1991.
3. Yoremkoren, **Robotics for Engineers**, McGraw-Hill, USA, 1987.
4. P.A. Janaki Raman, **Robotics and Image Processing**, Tata McGraw-Hill, 1991.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8230	**Operation Management**	SC	3	0	0	3	3
Prerequisites: Management		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To understand project management, methodology that will allow to initiate and manage the projects efficiently and effectively.
2. To know the use of project management tools, techniques and skills.
3. To understand how to manage the project cost, quality and delivery.
4. To learn the skill of selection and initiation of individual projects and portfolios of projects in the enterprise.

.**Course Outcomes:**

After completion of the course the student will be able to

1. Identify specific management needs in the execution of projects at tactical and strategic level.
2. Estimate the project proposals for scope, time and cost to consider its feasibility.
3. Synthesis the strategies to evolve suitable approach to accomplish the project with effective usage of the resources.
4. Illustrate the team building and leadership skills in planning and implementation of the project.
5. Apply effective management technique in the project execution to fulfill the desired objectives.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F8230	CO1	2	2	2										3	3	2
	CO2	2	1	3										3	3	2
	CO3	2	3	2										3	3	2
	CO4	2	3	2										3	3	2
	CO5	3	2	2										1	2	2

Course Content:

UNIT–1 **[12 hrs]**

Concept of Project Management: Concept of project, categories of projects, phase of project life cycle, roles and responsibility of a project leader, tools and technology for project management.

Organizing and Staffing: Project leader: skills/abilities required for project manager, authorities and responsibilities of project manager, project organization, types of accountability in project execution and control

UNIT-2 **[12 hrs]**

Project Planning and Estimation: Feasibility study and report, phased planning, project planning steps: objectives and goals of the project, preparation of cost estimation, finalization of project implementation, evaluation of the project profitability.

Project Procedure Manual: Contract management, configuration management, communication management, man management, time management, materials management, cost management, needs for flexibility.

UNIT – 3 **[12 hrs]**

Project Scheduling, Coordination and Control: Project implementation, scheduling-different techniques-GANTT charts, bar charts for combined activities, Project direction, communication in a project, project coordination, project control, scope and progress control performance control, schedule control and cost control, case study .

UNIT – 4 **[12 hrs]**

Performance Measures in Project Management and Project Inventory Management: Performance indicators, performance improvement for the CM and DM companies for better project management, nature of project inventory, supply and transportation of materials.

Project Implementation: project work system design, work break down structure (WBS), project execution plan (PEP)

Text Books

1. Herold Kerzner **Project Management, a system approach to planning, scheduling and controlling**- CBS publishers and distributors, 2002
2. Chaudhry S **Project Management** McGraw Hill 2010

Reference Books

1. Harvey Maylor **Project Management,** , 3rd edition, Pearson, 2003,

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8240	**Mechanics of Composite Materials**	SC	3	0	0	3	3
Prerequisites: Material Science		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To classify the composite materials, highlight their applications in key areas and introduce to fiber reinforced plastic processing.
2. To perform micromechanical and macro mechanical analysis of a lamina.
3. To introduce to various biaxial strength theories and macro mechanical analysis of a laminate.
4. To provide a detailed understanding of metal matrix composites including types, application, fabrication and properties.
5. To provide thorough knowledge on composites, metal matrix composites, micro/macro mechanical analysis of lamina/laminate.

Course Outcomes:

After completion of the course the student will be able to

1. Gain knowledge on classification of composites, their applications and processing.
2. Understand micro/macro mechanical analysis of lamina/laminate
3. Be familiar with various biaxial strength theories and understand macro mechanical analysis of a laminate.
4. Gain comprehensive knowledge on metal matrix composites.
5. Do Micro/Macro mechanical analysis of lamina/laminate and implement basic knowledge of composites in general and metal matrix composites in particular, in future project/Research.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F8240	CO1	3	3	2	2	1	1	1	-	-	-	-	-	3	2	1
	CO2	3	2	2	3	2	-	-	-	-	-	-	-	3	2	1
	CO3	3		2	2	1	-	-	-	-	-	-	-	3	1	2
	CO4	3	3	1	1	-	-	-	-	-	-	-	-	3	1	1
	CO5	3	2	2	1	-	-	-	-	-	-	-	-	3	1	2

Course Content:

UNIT – 1 [**12 hrs]**

Introduction to Composite Materials: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites.

Applications: Automobile, Aircrafts. Missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

Fiber Reinforced Plastic Processing: Layup and curing, fabricating process, open and closed mould process, hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

UNIT – 2 [**12 hrs]**

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems.

Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Two – dimensional relationship of compliance and stiffness matrix.

Macro Mechanics of a Lamina Hooke's law for two-dimensional angle lamina, engineering constants – Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

UNIT – 3 [**12 hrs]**

Biaxial Strength Theories: Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems.

Macro Mechanical Analysis of Laminate: Introduction, code, Kirchhoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) , Special cases of laminates, Numerical problems**.**

UNIT – 4 [**12 hrs]**

Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application.

Fabrication Process for MMC's: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.

Properties of MMC'S: Physical Mechanical, Wear, machinability and Other Properties. Effect of size, shape and distribution of particulate on properties.

Text Books

1. K. K. Chawla **Composite Science and Engineering,** Springer Verlag 1998.
2. Autar K. Kaw **Mechanics of composite materials,** CRC Press New York.

Reference Books

1. P. K. Mallick, Marcel **Fiber Reinforced Composites,** Dekker,Inc
2. Robert M. Jones,**Mechanics of Composite Materials**, McGraw Hill Kogakusha Ltd.1998
3. Meing Schwaitz," **Composite materials hand book,** McGraw Hill book company.1984
4. Gibron.**Principles of composite Material mechanics,** Ronald F. McGraw Hill international, 1994.
5. Madhujit Mukhopadhyay , **Mechanics of Composite Materials and Structures**, Universities Press 2009

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8310	**Biomass Energy**	SC	3	0	0	3	3

Prerequisites: Energy Resources	Internal Assessment	Semester End Exam
	40 Marks	60 Marks

Course Objectives:

1. Describe sources of bio mass energy and its characteristics
2. List and explain different bio mass conversion methods
3. Explain the principles of bio mass gasifiers and bio mass digesters.
4. Present the production techniques of bio diesel and its use in IC engines.
5. Explain basic thermodynamic cycle in bio power generation.

Course Outcomes:

After completion of the course the student will be able to

1. Describe the fundamentals and characteristics of bio mass energy sources
2. Describe different bio mass conversion methods to use as a fuel.
3. Explain the technological basis for harnessing bio mass energy sources.
4. Extract the bio fuel from biomass.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F8310	CO1	3	3	3	2	-	-	-	-	-	-	-	-	1	2	3
	CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	1	2
	CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2
	CO4	3	3	3	3	-	-	-	-	-	1	-	-	1	2	3

Course Content

UNIT – 1 **[12 hrs]**

Introduction: Biomass energy sources, energy content of various Bio – fuels, Energy plantation, origin of Biomass photo synthesis process, Biomass Characteristics, sustainability of Biomass.

Biomass Conversion Methods: Agrochemical, Thermo-chemical, Biochemical (flowchart) & Explanation.

UNIT – 2 **[12 hrs]**

Physical & Agrochemical Conversion: Briquetting, Pelletization, Agrochemical, fuel Extraction, Thermo chemical Conversion: Direct combustion for heat, Domestic cooking & heating.

Biomass Gasification: Chemical reaction in gasification, Producergas& the constituents, Types of gasifiers. Fixed bed gasifiers, Fluidized bed gasifiers. Liquefaction: Liquefaction through pyrolysis & Methanol synthesis, application of producer gas in I C Engines.

UNIT – 3 **[12 hrs]**

Bio-Methanization: Anaerobic digestion, Basic principles, factors influencing Biogas yield, classification of Biogas digester, floating gasholder & fixed dome type.(Working Principle with diagram), Calculations for sizing the Biogas plant.

Biogas For Power Generation: Ethanol as an automobile fuel, Ethanol production & its use in engines.

UNIT – 4 **[12 hrs]**

Bio – Diesel: Sources, production of bio diesel from non edible oils, Blending of Bio diesel, Performance analysis of diesel engines using bio diesel. Effect of use of bio diesel in I C engines.

Bio Power Plants: Bio Power generation routes, Basic Thermodynamic cycles in Bio power generation; Brayton cycle, Sterling cycle, Rankine cycle, Co-generation cycle. Biomass based steam power plant.

Text Books

1. B.T. Nijaguna. **Bio Gas Technology,** New Age International- New Delhi.2001-02
2. S. Rao & B. B. Parulekar **Energy Technology,**– Khanna Publishers, Delhi-1999.
3. G. D. Rai **Non Conventional Energy Sources,**– Khanna Publishers. Delhi.

Reference Books

1. G.N. Tiwari, **Greenhouse Technology for Controlled Environment,** Alpha Science International Ltd., Pangbourne.England.
2. John.W.Twidell, Anthony. D. Weir, **Renewable Energy Resources,** EC BG-2001.
3. Deglisc. X and P. Magne**, BioMass,** Millennium Enterprise, New Delhi.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8320	**Rapid Prototyping**	SC	3	0	0	3	3
Prerequisites: None		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To learn the fundamentals of Rapid prototyping and related concepts to understand the various materials used in the techniques.
2. To minimize sustaining engineering changes
3. To extent product life time by adding necessary features and eliminating redundant features early in the design.
4. To have a hands on experience on various tools used for modeling and manufacturing aspects of RP
5. To understand the role of rapid prototyping and rapid tooling.
6. To study about the programming aspects by using machine code languages for various operations using sophisticated software's (Manual and computer aided part programming)

Course Outcomes:

After completion of the course the Students will be able to

1. Apply the various techniques in order to produce Prototypes, a pattern development for rapid tooling and various RP software.
2. To know the impact of Rapid prototyping, Rapid tooling and Rapid manufacturing in the product development process.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F8320	CO1	2	1	1	-	-	-	-	-	-	-	-	-	3	1	1
	CO2	2	1	1	-	-	-	-	-	-	-	-	-	2	1	1

Course Content:

UNIT- 1 [**12 hrs]**

Introduction: Definition of RP, Prototypes, Types of prototypes, roles of prototypes, Need for the compression in product development, Impact of Rapid prototyping in product development, history of RP systems, Survey of applications, industry and classification of RP systems, Basic methodology of RP, Benefits and limitations.

Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.

UNIT -2 [**12 hrs]**

Solid Ground Curing: Principle of operation, Machine details, Applications

Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications.

Fusion Deposition Modeling: Principle, Process parameter, Path generation, Applications.

Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.

UNIT -3 [**12 hrs]**

Concepts Modelers: Principle, Thermal jet printer, Sander's model maker, 3-D printer., object Quadra systems.

Rapid Tooling: Indirect Rapid tooling, Silicon rubber tooling, Aluminium filled epoxy tooling, Spray metal tooling, 3D keltool, etc. Direct Rapid Tooling, Quick cast process, Copper polyamide, Rapid Tool, DMILS, , Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling.

Software for RP: STL files, Overview of Solid view, magic's, Mimics, magic communicator, etc. Internet based manufacturing.

UNIT -4 [**12 hrs]**

Rapid Manufacturing Process Optimization: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation.

Allied Process: surface digitizing, Surface generation from point cloud data, surface modification – data transfer to solid models.

Detail application with respect to Aerospace, medical, and automobile industry.

Text Books:

1. Paul F. Jacobs **Stereo Lithography and other RP & M Technologies**,: SME, NY 1996.
2. Pham D.T & Dimov, S.S Verlog **Rapid Manufacturing**, London 2001

Reference Books:

1. **Rapid Prototyping**, Terry Wohlers Wohler's Report 2000" Wohler's Association 2000.
2. Gurumurthi, **Rapid Prototyping Materials**, IISc Bangalore
3. Lament wood. **Rapid Automated**, Indus press New York

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8330	**Non Destructive Testing Methods**	SC	3	0	0	3	3
Prerequisites: None		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. Understand principle behind various NDT techniques and study about NDT equipments and accessories.
2. Learn working procedures of various NDT techniques
3. Learn materials that could be inspected – codes, standards, specifications.

Course Outcomes:

After completion of the course **t**he students will be able to:

1. Use NDT equipments and accessories.
2. Use the NDT techniques in practical applications.
3. Compare and select of various NDT techniques based on the applications

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
BTME15 F8330	CO1	3	1	3	1	2	2	1	1	1	1	1	1	3	2	1
	CO2	3	1	1	3	1	2	2	1	1	1	1	1	3	2	2
	CO3	2	1	1	2	2	2	1	2	-	2	1	1	3	2	1

Course Content:

UNIT-1 [**12 hrs]**

Non-Destructive Testing: Introduction to various non destructive methods- Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.

UNIT-2 **[12 hrs]**

Liquid Penetrant Testing, Magnetic Particle Testing: Physical principles, procedure for penetrate testing, Penetrant Testing materials, Penetrant testing methods – water washable, post – Emulsifiable methods, Applications Principle of MPT, procedure used for testing a component , Equipment used for MPT, Applications

UNIT-3 [**12 hrs]**

Eddy Current Testing, Acoustic Emission

Principles, Instrumentation for ECT, Absolute – differential probes, Techniques – High sensitivity Techniques, Applications Principle of AET, Instrumentation, Applications – testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT-4 [**12 hrs]**

Ultrasonic Testing: Principle , Ultrasonic transducers ,Inspection Methods, Normal Inscudent Pulse – Echo Inspection , Through – transmission Testing , angle Beam Pulse – Echo testing , Techniques for Normal Beam Inspection , Ultrasonic Flaw detection Equipment , Modes of display A- scan , B-Scan , C-Scan ,Applications.

Radiography , Comparison and selection of NDT methods

Basic principle, Effect of radiation on Film, Radiographic imaging , Inspection Techniques – Single wall single image , Double wall Penetration , Multiwall Penetration technique. Comparison and selection of various NDT techniques

Text Book:

1. Baldev raj, T Jeyakumar, M. Thavasimuthu **Practical Non Destructive Testing** Narosa publishing house, New Delhi, 2002

Reference Books:

1. Krautkramer. J., **Ultra Sonic Testing of Materials**, 1st Edition, Springer Verlag Publication, New York, 1996.
2. Peter J. Shull Non Destructive Evaluation: **Theory, Techniques and Application** Marcel Dekker, Inc., New York, 2002

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8340	**Machine Tool Design**	SC	3	0	0	3	3
Prerequisites: Manufacturing Process		Internal Assessment			Semester End Exam		
		40 Marks			60 Marks		

Course Objectives:

1. To know the design consideration for the manufacturing and selection of tool.
2. To Know the tool life and there regulation when it is under operating condition.

Course Outcomes:

After completion of the course the student will be able to

1. Describes the tool life and manufacturing of different tools.
2. Explains the regulation and general consideration for the selection of tool.
3. Work using computer software and simulation of tool.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F8340	CO1	3	1	3	1	2	2	1	1	1	1	1	1	3	2	1
	CO2	3	1	1	3	1	2	2	1	1	1	1	1	3	2	2
	CO3	3	2	1	1	3	1	2	2	1	1	1	1	2	1	1

Course Content:

UNIT – 1 **[12 hrs]**

Principles Of Machine Tool Design: General requirements of machine tool design – design process machine tool layout general requirements of machine tool design – design process machine tool layout.

Machine Tool Drives and Mechanisms: Working and auxiliary motion. Drives- Electric drives, Hydraulic transmission, Kinematic structure, Regulation of speed and feeds, stepped regulation, standardization of speed and feed, step less regulation of speeds and feeds.

UNIT – 2 **[12 hrs]**

Cutting Force Analysis and Power Requirement: In Turning, Milling, Drilling, Shaping and Broaching operation with simple problems. General requirements of machine tools – Centre lathe, Milling machine.

Design of Machine Tool Structures: Functions-Requirements-Design criteria Material used – static and dynamic stiffness – Profile and basic design procedure for machine tool structures. Design of beds, columns, housing, bases, tables, cross-rails, arms saddle, carriages.

UNIT – 3 **[12 hrs]**

Design of Guide Ways and Power Screws: Function and types of guide ways – Design and lubrication of slide ways –antifriction guide ways, protecting devices, design of power screws.

Design Of Spindle And Spindle Bearings: Functions-Requirements and materials for spindle compliance and machining accuracy. Design of spindles, antifriction bearing, Hydrodynamic and Hydrostatic bearing, Air lubricated bearing.

UNIT –4 **[12 hrs]**

Dynamics of Machine Tools: Concept of dynamic cutting process, Physical causes of chatter and vibrations, Types of Chatter. Stability chart, chatter vibration in Lathe, Drilling machine, Grinding machine and Milling machine. Different methods for avoiding machine tool chatter and vibration.

Control Systems in Machine Tools: Functions, requirements and classification. Control system for speed and feeds centralized control pre selective control, control system for forming and auxiliary motions – Mechanical control– Ergonomic consideration and compatibility – Automatic control system – Electric Hydraulic and pneumatic systems.

Text Books

1. N.K. Mehta, **Machine Tool Design,** 2nd Ed., Tata McGraw Hill 2001
2. Sen and Bhattacharaya **Principles of Machine Tools,** Oxford IBM Publishing 2000

Reference Books

1. N. Acharkan **Machine Tool Design Volume – II and III,** MIR Publications 2000
2. S. K. Basu and D. K. Pal **Design of Machine Tools**, 2000
3. Koensberger **Principles of Machine Tool Design**,

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
BTME15F8440	**PROJECT**	HC	0	0	10	10	--
Prerequisites: Nil		Internal Evaluation			Semester End Evaluation		
		50 Marks			50 Marks		

Course Objectives:

1. To identify the problem in real time application and find out the solution
2. To make the students to convert their ideas in to reality.
3. To develop the skill of writing, documentation and presentation.

Course Outcomes:

After completion of the course the student will be able to
1. Identify the problems in the real time application.
2. Apply the knowledge to analyze the problem.
3. Document the progression of the work and results.
4. Design the process/ product for simple applications.

The students have to make a project team of minimum two candidates to maximum of four candidates and select the problems from an industry or in the society or any innovative ideas. The project team has to work for the solution or converting their ideas into product and present the progress of the work in two phases which will be evaluated for 50 marks. At the end of the semester the students have to submit the hard copy of the report which will be prepared as per the guidelines/format of the university. Semester end evaluation will be conducted batch wise.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
BTME15 F8440	CO1	3	3	3	-	-	-	2	1	3	3	3	2	3	1	3
	CO2	3	2	3	-	1	-	1	-	3	2	2	2	3	2	2
	CO3	3	2	3	2	-	2	3	-	3	3	2	2	3	3	2
	CO4	3	2	3	-	-	-	2	1	3	2	1	2	3	2	3