

Ordinance No. V(2A)

Bachelor of Technology

(B.Tech.)

(Discipline: Mechanical Engineering)



Faculty of Engineering & Technology

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
SUBHARTI INSTITUTE OF TECHNOLOGY AND ENGINEERING
ORDINANCE No. V (2A) RELATING TO
BACHELOR OF TECHNOLOGY (B.Tech.) PROGRAMME
(As per AICTE)
(Effective from the Session – 2018-19)

General

- This ordinance may be called “**Ordinance Relating to Bachelor of Technology (B.Tech)**” Programme.
- It shall come enforced with immediate effect from session 2018-19.
- This supersedes the previous Ordinance relating to Bachelor of Technology (B.Tech) Programme ordinance no. [V (2A)].
- The degree “Bachelor of Technology” acronym as B.Tech shall be of four years (eight semesters) in the branches of Engineering prevalent in the institute at a point of time based on Choice Based Credit System (CBCS) as per AICTE guidelines.

CHAPTER – 1

1.1 Introduction

Chhatrapati Shahuji Subharti Institute of Technology and Engineering is a constituent Institute of Swami Vivekanand Subharti University, Meerut has been established in 2005 with the vision we make every decision to support the career and personal development of our learners. Our curriculum, teaching and services demonstrate that we value the diverse profiles of our learners. The University boasts of highly qualified, dedicated and competent faculty from all walks of life, world class infrastructure, fully equipped Laboratories with latest state-of-the-art equipment and a huge library with recent knowledge resources including e-resources. Swami Vivekanand Subharti University providing a safe and healthy working environment for teaching and non-teaching employees, students, and visitors etc.

1.2 Vision

To become a dynamic, demand driven, quality conscious, efficient and innovative institute capable of becoming active partner in the techno-economic growth of the Nation and to provide world class technological education and research inputs to the society.

1.3 Mission

Strive to create centre of excellence in specialized areas of technology and enable its academic beneficiaries to become competent professionals capable of providing sustainable solutions to challenging problems of the society and industry.

1.4 Programme Educational Objectives (PEOs):

The Programme Educational Objectives of B.Tech. programmes are:

PEO1. To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms

PEO2. To prepare graduates who will contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise

PEO3. To prepare graduates who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, design and implementation skills

PEO4. To prepare graduates who will thrive to pursue life-long learning to fulfill their goals

1.5 Programme Outcomes (POs):

Engineering programmes are designed to prepare graduates to attain the following program outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

CHAPTER-2

Eligibility for Admission

- 2.1 (i) An applicant is eligible for admission in the 1 Year of the B.Tech. programme provided that, he/she should be at least 17 years on 31 December of the year of admission. The upper age limit for taking admission in Under Graduate programme will be 30 years. (as per SVSU Letter No. U-07/SVSU/2016/374 dated 16.08.2016)
- (ii) An applicant should have passed intermediate examination or an equivalent examination from any recognized board/university with Physics, Mathematics as compulsory subjects, Chemistry/Bio-technology/Computer Science/Biology as one of the optional subjects.
- (iii) The admission shall be considered purely on the basis of merit in the University entrance test and counseling conducted by the university. The applicant who have 45 % of marks (40 % for SC/ST) [as per AICTE norms*] or more in the above mentioned three subjects and not less than 45 % marks (40 % for SC/ST) in the optional subjects will be considered for direct admission against seats, which might not have been filled up through the examination and counseling.
- (iv) The applicant who has obtained a two/three year Engineering Diploma with Minimum (45 %) aggregate marks from a recognized Institute/University will be considered eligible for direct admission in the second year of the B.Tech programmes.
- (v) The applicant having a three year B.Sc. degree with Mathematics with a minimum of 40 % marks in aggregate from a recognized university will be considered eligible for direct admission in the second year of the B.Tech programmes. Provided that the students belonging to B.Sc. Stream, shall clear the subjects Engineering Graphics/Engineering Drawing and Engineering Mechanics of the First Year Engineering Programme along with the Second year subjects.
- (vi) Provided that the students belonging to B.Sc. Stream shall be considered only after filling the supernumerary seats in this category with students belonging to the Diploma Stream.

* Subject to moderation in accordance with the guidelines of AICTE

- 2.2** The B.Tech. programme is available in the following discipline:
- (i) Computer Science & Engineering
 - (ii) Information Technology
 - (iii) Electrical & Electronics Engineering
 - (iv) Electronics & Communication Engineering
 - (v) Mechanical Engineering
 - (vi) Civil Engineering
 - (vii) Food Technology
- 2.3** Selected candidates shall be allocated a discipline from those listed in clause 2.2 on the basis of merit, choice and counseling.
- 2.4** Request for change in discipline may be considered on the basis of merit in the entrance examination provided that the seat remains vacant after the last date for admission in B.Tech. programme.
- 2.5** After 2nd Semester, a student can apply for change of branch which shall be considered on the following grounds:
- (i) Availabilities of seats in branch as per sanctioned intake by AICTE.
 - (ii) The students should have passed 1st and 2nd Semester examination without any carry over paper.
 - (iii) The branch from which the students will be shifted must not fall below 75 % of its sanctioned intake.
- 2.6** The change of discipline shall be allowed only once during the programme.

CHAPTER-3

Teaching Course

- 3.1** The programme will be of four years duration, divided in to eight semesters.
- 3.2** The duration of the B. Tech. programme for the candidates admitted in semester I will be four academic years (eight semesters).
- 3.3** The duration of the B. Tech. programme for the candidates admitted in semester III (lateral entry) will be three academic years (six semesters).
- 3.4** Annual academic calendar shall be published by the University.
- 3.5** There shall be normally 14 weeks of teaching in every semester.
- 3.6** Study & evaluation scheme is enclosed as an Annexure A1-A7.

CHAPTER-4

Curriculum/Structure

4.1 The programme shall be spread over four academic years, spread over eight semesters comprising actual teaching for a minimum of 90 days in each semester.

4.2 The programme focuses on the following aspects:

- (a) Competency
- (b) Entrepreneurship
- (c) Skill Enhancement
- (d) Value Added Courses
- (e) Extracurricular activities

4.3 Choice Based Credit System (CBCS) :

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising Professional/Program Core Courses (PCC), Professional/Program Elective Courses (PEC), Engineering Science Courses (ESC), Basic Sciences Courses (BSC), Humanities and Social Sciences including Management Courses (HSMC) Mandatory Courses (MC) and Open Elective Courses (OEC). The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

4.3.1 Structure of Undergraduate programs

The four year B. Tech. programme compromise of courses divided in seven distinct areas, namely: Professional/Program Core Courses (PCC), Professional/Program Elective Courses (PEC), Engineering Science Courses (ESC), Basic Sciences Courses (BSC), Humanities and Social Sciences including Management Courses (HSMC) Mandatory Courses (MC) and Open Elective Courses (OEC). All the courses offered in first year B. Tech. programs are categorized as 'Common Courses' for all the academic programs. Credits assigned and curricular components of the B. Tech. curriculum are given in Annexure A1-A7.

Professional/Program Core Courses (PCC)

The departmental core consists of courses considered essential for a chosen Engineering/Science discipline including, Engineering design, Seminar, Industrial Training and Project (PROJ).

Professional/Program Elective Courses (PEC)

The students are required to complete a specific number of elective courses. Every department offers a wide variety of elective courses to students providing them opportunity to discover their academic interest and enhancing their engagement in learning process.

Open Elective Courses (OEC)

The Open Electives courses are offered by different academic departments to the students of all disciplines. A wide range of elective courses is available with each branch. When a student opts elective courses offered in his/her program it will be termed as OE.

Humanities and Social Sciences including Management Courses (HSMC)

The Humanities, Social Sciences and Management Courses consist of courses considered essential for a B.Tech. program to inculcate the essence of technical writing, communication skills, economics and analysis, management and professional ethics & human values.

Basic Sciences Courses (BSC)

The Applied Sciences and Mathematics Courses consist of courses considered essential for a B.Tech. program to build the foundation for learning of engineering core courses.

Engineering Science Courses (ESC)

The students are required to complete a minimum number of Allied engineering courses (majority of them taught as common courses) offered by engineering departments other than his/her parent department. These courses expose the student with wide spectrum knowledge of allied engineering domain connected to the main engineering stream of the course of study of the students of concerned departments.

Mandatory Courses (MC)

The mandatory courses considered essential for a B.Tech. programme to inculcate the essence of Environmental Sciences, Induction program, Indian Constitution, Essence of Indian Knowledge Tradition etc.

4.4 Induction Program

Three weeks duration Induction program for students to be offered right at the start of the first year. These activities are listed under following 7 heads:

1. Physical and Health
2. Culture
3. Literature and Media
4. Social Service
5. Self development
6. Nature and Environment
7. Innovation

4.5 The academic calendar shall be as follows:-

I , III , V, VII Semester (Odd)	Session - 1st Aug. to 30th Nov Exam - 1st Dec. to 20th Dec.
II, IV, VI, VIII Semester (Even)	Session - 1st Jan. to 10th May Exam - 1st May to 20th May

CHAPTER-5

Attendance

- 5.1 The students are expected to attend all the classes and should not have less than 75 % attendance in theory as well as in practical classes, wherever held, to become eligible to appear for the university examination. Short fall in attendance can, however be condoned in deserving cases to the extent of 10 % by the Principal. If the short fall is more than 10 % but not more than 15 %, the Principal may recommend deserving cases to the Vice Chancellor for condo-nation. The order of the Vice Chancellor in this regard shall be final.

CHAPTER-6

Examination

All Courses offered by SITE will have an evaluation system within two components as:

1. Continuous Comprehensive Assessment (CCA) accounting for 30% of the final grade that a student gets in a course, and
2. End-Semester Examination (ESE) accounting for the remaining 70% of the final grade that the student gets in a course.

A student will have to pass both the components i.e. CCA and ESE separately to become eligible to be declared successful in a course.

6.1 Continuous Comprehensive Assessment (CCA)

Award of Sessional Marks:

Sessional marks for theory subjects and practicals and shall be awarded as per the breakup of sessional marks given below:-

(i) Theory Subjects :

(a) Class test will comprise two mid-term test of equal weightage. - **20 Marks**

(b) Marks for regular class attendance - **10 Marks**

(ii) Practical :

(a) Two–mid-term viva-voce test of equal weightage. - **5 Marks**

(b) Teacher’s assessment (including 5 marks for regular attendance) based on lab record attendance - **10 Marks**

(iii) Make-up test may be held for those students who fail to appear in any one of the mid-term class test due to genuine unavoidable reasons, provided prior permission was consented from the Principal.

(iv) A maximum of 10 marks in each subject shall be awarded for attending classes (theory/practical) as per the following norms:

85 % or more attendance	-	10 Marks
80 % or more but less than 85 % attendance	-	09 Marks
75 % or more but less than 80 % attendance	-	08 Marks
70 % or more but less than 75 % attendance	-	07 Marks
65 % or more but less than 70 % attendance	-	06 Marks
60 % or more but less than 65 % attendance	-	05 Marks
51 % or more but less than 60 % attendance	-	04 Marks
50 % attendance	-	01 Marks
Less than 50 % attendance	-	0 Marks

6.2 Award of General Proficiency Marks:

The marks in General Proficiency shall be awarded on the following basis:-

- (i) Co-curricular & Extra-curricular activities (games, sports, cultural and literary activities etc.) **50%**
- (ii) Discipline inside and outside the college campus (including 10 marks for regular attendance) **50%**

6.3 The marks for seminar, industrial training and educational tour shall be awarded on the following basis:

- (i) Write-up/Report 50%
- (ii) Presentation 50%

6.4 END SEMESTER EXAMINATION (ESE)

The remaining 70% of the final grade of the student in a course will be assessed on the basis of an end semester examination (ESE) that will be for three hours duration and will cover the entire syllabus of the course. The question papers for the ESE will be got set by the Controller of Examinations (COE) of the Swami Vivekanand Subharti University (SVSU) by a selected faculty panel.

6.5 The entire programme has to completed within a maximum of seven years from the date of original admission in the programme by those students who are admitted in the first year and within six years by those admitted directly in the Second Year, [Vide clause 2.1 (iv, v)]

CHAPTER-7

Paper Setting

7.1 The work of setting the end semester examination papers and evaluation of scripts and conduct of the end semester practical examination shall be assigned to the course teachers as well as to outsiders, ordinarily in the ratio of 50:50 for internal and external valuation respectively.

Results

7.2 The result shall be prepared at the end of each academic year of the programme by aggregating the marks obtained in the theory and practical examinations in all the semesters of the programme till date.

- (a) The minimum passing marks in each theory subject (including sessional marks) shall be 40% and 50% in aggregate. The minimum pass marks in a project/ Practical subject (including sessional marks if any), Seminars, Industrial Training and Educational Tour, Viva-Voce etc. shall be 50%.
- (b) If a student obtained 40% marks in at least 50% of the papers (ignoring fractions) including project report, he/she will be provisionally promoted to the next year with carryover papers and will have to appear & obtain pass marks in carryover papers along with the subsequent regular examinations for the relevant semester.
- (c) If a candidate fails in only one head/subject and having passed in all other head/subject of the given examination of the year than his/her deficiency of maximum five (05) marks may be fulfilled by grace marks after fulfilling the conditions given below:

7.3 If a candidate fails in only one head/subject and having passed in all other heads/subjects of the given examination of a **semester*/year**, then his/her deficiency of marks may be fulfilled by grace marks under the following conditions:-

- (i) Grace marks is not a matter of right of the student but is the discretion of the University.
- (ii) Provided that the candidate has appeared in the main examination of the concerned programme and falls short of pass marks by not more than five (05) marks in theory paper only. Benefit of above mentioned shall not be given to the candidate who had appeared in supplementary/special examination/carry over examination.
- (iii) Further, benefit of grace marks may be given only to the candidate who will pass the entire concerned examination of the **semester*/year** after awarding the grace marks and not for the purpose of promoting the student to next year with back papers or for improvement of division or percentage.
- (iv) If in a head/subject of an examination passing in Theory, Practical or sessional exams separately is mandatory, then the benefit of grace marks shall be given only in Theory examination of the University examination.
- (v) The award of grace marks permissible shall be on the basis of 1 grace mark for every 05 marks secured by an examinee over and above the minimum passing aggregate marks of all subjects of the year.

7.4 Awarding of Grace Marks shall be done as given below:-

Aggregate Marks Obtained over & above minimum passing marks	Permissible Grace Marks
1-5	1
6-10	2

11-15	3
16-20	4
21-25	5

Total number of Grace Marks given to the student will be marked with astrick (*) at the bottom of the mark sheet.

* Grace Mark in semester examination will be considered hereinafter.

A student not covered by clause 7.2 (a) to (c) above shall have the following options to complete his/her programme -

- (i) He/ she may take admission on payment of full annual programme fee and repeat the entire year of study. He /She shall be treated as a regular student. Or
- (ii) He /She may pay only University exam fee for the End Semester Examination and appear in the End Semester University exams directly. He /She shall not be allowed to attend classes and the Sessional marks obtained earlier shall be retained. Or
- (iii) He /She may pay half of the annual programme fee and attend classes. The sessional marks obtained by him/her earlier shall be retained. There will not be any requirement of minimum attendance for appearing in the University examination

7.5 A student will not be promoted to the next academic year if the carryover papers are more than 50% at one point of time.

Evaluation under Grading Assessment

7.6 The minimum Grade/ Grade Point required to pass each paper in a semester examination under CBCS shall be Grade D/ Grade Point 4 in each theory paper/ Practical/Project (wherever applicable) in External Examination and Internal Assessment separately.

Calculation Criteria

7.7 To implement the following grading system, the colleges/campuses shall use the following UGC recommended 10 point grading system:

Marks (%)	Letter Grades	Grade Points (G)
85-100	A++ (Outstanding)	10
75 to < 85	A+ (Excellent)	9
70 to <75	A (Very Good)	8
65 to <70	B+ (Good)	7
60 to <65	B (Above Average)	6
50 to <60	C (Average)	5
40 to <50	D (Pass)	4
0 to <40	F (Fail)	0
	AB (Absent)	0

7.8 Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

$$(S_i) = \frac{\sum (C_i \times G_i)}{\sum C_i},$$

where C_i is the number of credits of the i^{th} programme and G_i is the grade point scored by the student in the i^{th} programme.

$$\text{CGPA} = \frac{\sum (C_i \times S_i)}{\sum C_i}$$

where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

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

CHAPTER-8

Power to Modify

- 8.1** In the event of any emergent situation, if any deviation is considered necessary, the Vice-Chancellor is authorized to modify the ordinance. Subjected to subsequent ratification by the executive council.



**SWAMI VIVEKANAND
SUBHARTI UNIVERSITY, MEERUT**



EVALUATION SCHEME & SYLLABUS

B.TECH.

(Mechanical Engineering)

W.E.F. SESSION 2018-19

SUBHARTI INSTITUTE OF TECHNOLOGY AND ENGINEERING
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B.TECH. (MECHANICAL ENGINEERING)

FIRST SEMESTER

Sl/No	Category	Subject Code	Subject Name	L-T-P	Th/Lab Marks (ESE)	Sessional		Total	Credit
						CT	TA		
1	Basic Science Courses	BAS-101/ BAS102	Physics - 1(Electromagnetism)/ Chemistry-1	3-1-0	70	20	10	100	4
2	Basic Science Courses	BAS-103	Mathematics I (Calculus &linear algebra)	3-1-0	70	20	10	100	4
3	Engineering Science Courses	BEEE-101/BCSE -101	BasicElectrical Engineering /Programming for problem solving	3-1-0	70	20	10	100	3
4	Engineering Science Courses	BME-151/152	Engineering Graphics & Design Lab / Workshop/Manufacturing practices Lab	1-0-4	35	--	15	50	3
5	Basic Science Courses	BAS-151/BAS-152	Physics -1 Lab / Chemistry Lab	0-0-3	35	--	15	50	1.5
6	Engineering Science Courses	BEEE-151/BCSE -151	BasicElectrical Engineering Lab/ Programming for problem Solving Lab	0-0-2	35	--	15	50	2
TOTAL								450	17.5

B.TECH. (MECHANICAL ENGINEERING)

SECOND SEMESTER

Sl/No	Category	Subject Code	Subject Name	L-T-P	Th/Lab Marks (ESE)	Sessional		Total	Credit
						CT	TA		
1	Basic Science Courses	BAS-201/BAS-202	Physics -1 (Electromagnetism)/ Chemistry-1	3-1-0	70	20	10	100	4
2	Basic Science Courses	BAS-203	Mathematics II (ODE & complex variables)	3-1-0	70	20	10	100	4
3	Engineering Science Courses	BEEE-201/BCSE-201	Basic Electrical Engineering / Programming for problem solving	3-0-0	70	20	10	100	3
4	Humanities and social sciences including Management courses	BHU-201	English	2-0-0	70	20	10	100	2
5	Engineering Science Courses	BME-251/252	Engineering Graphics & Design Lab / Workshop/Manufacturing practices Lab	1-0-4	35	--	15	50	3
6	Basic Science Courses	BAS-251/BAS-252	Physics -1 Lab / Chemistry Lab	0-0-3	35	--	15	50	1.5
7	Engineering Science Courses	BEEE-251/BCSE-251	Basic Electrical Engineering Lab/ Programming for problem Solving Lab	0-0-4	35	--	15	50	2
8	Humanities and social sciences including Management courses	BHU-251	English lab	0-0-2	--	35	15	50	0
TOTAL								600	20.5

List of MOOCs (NPTEL) based recommended courses for first year B.Tech. Students

1. Development soft skills and personality

2. Enhancing soft skills and personality

Humanities and social sciences including Management courses

BHU -201 : English

BHU -202 :Industrial Psychology

BHU -203 :Operations Research

BHU -204 :Economics

BHU -205 :Finance& Accounting

B.TECH. (MECHANICAL ENGINEERING)

THIRD SEMESTER

Sl/No	Category	Subject Code	Subject Name	L-T-P	Th/Lab Marks (ESE)	Sessional		Total	Credit
						CT	TA		
1	Basic Science Courses	BAS-303	Physics II (Optics & Waves)	3-1-0	70	20	10	100	4
2	Basic Science Courses	BAS-301	Mathematics III (PDE, Probability & Statistics)	3-1-0	70	20	10	100	4
3	Basic Science Courses	BAS-304	Biology	3-0-0	70	20	10	100	3
4	Engineering Science Courses	BECE-305	Basic Electronics Engineering	3-1-0	70	20	10	100	4
5	Engineering Science Courses	BME- 301	Engineering Mechanics	3-1-0	70	20	10	100	4
6	Professional Core Courses	BME- 302	Thermodynamics	3-1-0	70	20	10	100	4
7	Mandatory course	BMC-301-305	--	2-0-0	70	20	10	100	0
TOTAL								700	23

Mandatory courses

BMC-301/BMC-401/BMC-501 : Constitution of India

BMC-302/BMC-402/BMC-502 : Universal Human values -1(During Induction Program)

BMC-303/BMC-403/BMC-503: Environmental science

BMC-304/BMC-404/BMC-504:Essence of Indian knowledge Tradition

BMC-305/BMC-405/BMC-505:Learning an art from (During Induction Program)

B.TECH. (MECHANICAL ENGINEERING)

FOURTH SEMESTER

Sl/No	Category	Subject Code	Subject Name	L-T-P	Th/Lab Marks (ESE)	Sessional		Total	Credit
						CT	TA		
1	Professional Core Courses	BME-401	Applied Thermodynamics	3-1-0	70	20	10	100	4
2	Professional Core Courses	BME-402	Fluid Mechanics & Fluid Machines	3-1-0	70	20	10	100	4
3	Professional Core courses	BME-403	Strength of Materials	3-1-0	70	20	10	100	4
4	Engineering Science courses	BME-404	Materials Engineering	3-0-0	70	20	10	100	3
5	Professional Core courses	BME-405	Instrumentation & Control	3-1-0	70	20	10	100	4
6	Mandatory courses	BMC-401-405	--	0-0-0	70	20	10	100	0
TOTAL								600	19

Mandatory courses

BMC-301/BMC-401/BMC-501 : Constitution of India

BMC-302/BMC-402/BMC-502 : Universal Human values -1(During Induction Program)

BMC-303/BMC-403/BMC-503: Environmental science

BMC-304/BMC-404/BMC-504:Essence of Indian knowledge Tradition

BMC-305/BMC-405/BMC-505:Learning an art from (During Induction Program)

B.TECH. (MECHANICAL ENGINEERING)

FIFTH SEMESTER

Sl/No	Category	Subject Code	Subject Name	L-T-P	Th/Lab Marks (ESE)	Sessional		Total	Credit
						CT	TA		
1	Professional Core Courses	BME-501	Heat Treansfer	3-1-0	70	20	10	100	4
2	Professional Core Courses	BME-502	Solid Mechanics	3-1-0	70	20	10	100	4
3	Professional Core Courses	BME-503	Manufacturing Processes	3-0-0	70	20	10	100	3
4	Professional Core Courses	BME-504	Kinematics & Theory of Machines	3-1-0	70	20	10	100	4
5	Humanities and social sciences including Management courses	BHU-501	Humanities I	3-0-0	70	20	10	100	3
6	Professional Core Courses	BME-551	Mechanical Engineering Laboratory (Thermal) -I	0-0-3	35	--	15	50	1.5
7	Mandatory Courses	BMC-501-505	--	0-0-0	70	20	10	100	0
8	Project (Summer Internship)	-BME 552	Project –I	0-0-0 (30Hrs) Total	--	--	50	50	1
TOTAL								700	20.5

Humanities and social sciences including Management courses

BHU-501/BHU-601: English

BHU-502/BHU-602:Industrial Psychology

BHU-503/BHU-603:Operations Research

BHU-504/BHU-604:Economcs

BHU-505/BHU-605: Finance & Accounting

Mandatory courses

BMC-301/BMC-401/BMC-501 : Constitution of India

BMC-302/BMC-402/BMC-502 : Universal Human values -1(During Induction Program)

BMC-303/BMC-403/BMC-503: Environmental science

BMC-304/BMC-404/BMC-504:Essence of Indian knowledge Tradition

BMC-305/BMC-405/BMC-505:Learning an art from (During Induction Program)

B.TECH. (MECHANICAL ENGINEERING)

SIXTH SEMESTER

Sl/No	Category	Subject Code	Subject Name	L-T-P	Th/Lab Marks (ESE)	Sessional		Total	Credit
						CT	TA		
1	Professional Core Courses	BME-601	Manufacturing Technology	4-0-0	70	20	10	100	4
2	Professional Core Courses	BME-602	Design of Machine Elements	3-1-0	70	20	10	100	4
3	Professional Elective Courses	BME-621-625	Elective-I	3-0-0	70	20	10	100	3
4	Professional Elective Courses	BME-621-625	Elective-II	3-0-0	70	20	10	100	3
5	Humanities and social sciences including Management courses	BHU-601-605	Open Elective - II (Humanities)	3-0-0	70	20	10	100	3
6	Professional Core Courses	BME-651	Mechanical Engineering Laboratory (Design) -II	0-0-3	35	--	15	50	1.5
7	Project (OR Summer Internship)	BME 652	Project –II	0-0-6 (90Hrs) Total	100	--	50	150	3
	TOTAL							700	21.5

Professional Elective courses BME (621-625)

BME-621: Internal Combustion Engine

BME-622:Mechatronics Systems

BME-623: Microprocessor in Automation

BME-624:Composite Materials

BME-625: Computer aided Design

Humanities and social sciences including Management courses

BHU-501/BHU-601: English

BHU-502/BHU-602:Industrial Psychology

BHU-503/BHU-603:Operations Research

BHU-504/BHU-604:Economcs

BHU-505/BHU-605: Finance & Accounting

B.TECH. (MECHANICAL ENGINEERING)

SEVENTH SEMESTER

Sl/No	Category	Subject Code	Subject Name	L-T-P	Th/Lab Marks (ESE)	Sessional		Total	Credit
						CT	TA		
1	Professional Corecourses	BME 701	Automation in Manufacturing	3-0-0	70	20	10	100	3
2	Professional Elective courses	BME- (721–725)	Elective III	3-0-0	70	20	10	100	3
3	Professional Elective courses	BME (721 – 725)	Elective-IV	3-0-0	70	20	10	100	3
4	Open Elective courses	BME-071	Open Elective-III	3-0-0	70	20	10	100	3
5	Professional Core courses	BME-751	Mechanical Engineering Laboratory III (Manufacturing)	0-0-3	35	--	15	50	1.5
6	Project	BME-752	Project-III	0-0-10	150	--	100	250	5
	TOTAL							700	18.5

Professional Elective courses(421- 425)

BME- 721 :Refrigeration and Air Conditioning

BME- 722 :Finite Element Analysis

BME- 723 :Power Plant Engineering

BME- 724 :Gas Dynamics and Jet Propulsion

BME- 725 :Process Planning and Cost Estimation

Open Elective course

BME 071 :Nano Technology & Surface Engineering

B.TECH. (MECHANICAL ENGINEERING)

EIGHTSEMESTER

Sl/No	Category	Subject Code	Subject Name	L-T-P	Th/Lab Marks (ESE)	Sessional		Total	Credit
						CT	TA		
1	Professional Elective courses	BME-(831-835)	Elective-V	3-0-0	70	20	10	100	3
2	Professional Elective courses	BME-(831-835)	Elective VI	3-0-0	70	20	10	100	3
3	Open Elective courses	BME-(081-089)	Open Elective-IV	3-0-0	70	20	10	100	3
4	Open Elective courses	BME-(081-089)	Open Elective-V	3-0-0	70	20	10	100	3
5	Project	BME-851	Project-IV	0-0-12	200	--	100	300	6
TOTAL								700	18

Total Credits – 158.5

Professional Elective courses (831- 835)

BME- 831 :Principles of Management

BME- 832 :Automobile Engineering

BME- 833 :Design of Transmission Systems

BME- 834 :Total Quality Management

BME- 835 :Energy Conservation and Management

Open Elective courses (081- 089)

BME 081: Soft Skills and Interpersonal Communication

BME 082 ICT for Development

BME 083 Human Resource Developments and Organizational Behavior

BME 084 Cyber Law and Ethics

BME 085 Introductions to Philosophical Thoughts

BME 086 Comparative Study of Literature

BME 087 Indian Music Systems

BME 088 Histories of Science & Engineering

BME 089 Introductions to Art and Aesthetics

B.TECH. (MECHANICAL ENGINEERING)

FIRST SEMESTER

BAS-101/201	PHYSICS-1	HOOR	CREDITS
	(Electromagnetism)	3L:1T:0P	4

Physics

Introduction to Electromagnetic

Theory Prerequisite: Mathematics course with vector calculus

Module 1: Electrostatics in vacuum (8)

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Module 2: Electrostatics in a linear dielectric medium (4)

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Module 3: Magnetostatics (6)

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Module 4: Magnetostatics in a linear magnetic medium (3)

Magnetization and associated bound currents; auxiliary magnetic field \vec{H} ; Boundary conditions on \vec{B} and \vec{H} . Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Module 5: Faraday's law (4)

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic braking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Module 6: Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations (5)

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displacement current and magnetic field arising from time-dependent electric field; calculating magnetic field due to changing electric fields in quasi-static approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Module 7: Electromagnetic waves (8)

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Text Book:

- (i) David Griffiths, Introduction to Electrodynamics

Reference books:

Halliday and Resnick, Physics

W. Saslow, Electricity, magnetism and light

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:.

Rationalise bulk properties and processes using thermodynamic considerations.
 Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
 Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.

BAS-103	MATHEMATICS-1	HOURL	CREDITS
	(Calculus & Linear algebra	3L:1T:0P	4

Contents

Module 1: Calculus: (6 lectures)

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module 2: Calculus: (6 lectures)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 3: Sequences and series: (10 lectures)

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 4: Multivariable Calculus (Differentiation): (8 lectures)

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Module 5: Matrices (10 lectures)

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

Suggested Text/Reference Books

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
N.P. Bali and Manish Goyal, A text book of Engineering

Mathematics, Laxmi Publications, Reprint, 2008.

(vii)B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

The students will learn:

To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.

The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

The tool of power series and Fourier series for learning advanced Engineering Mathematics.

To deal with functions of several variables that are essential in most branches of engineering.

The essential tool of matrices and linear algebra in a comprehensive manner.

BEEE-101/201	Electrical Engineering	3L:1T:0P	3 credits
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Module 1: DC Circuits (8 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Transformers (6 hours)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module 4: Electrical Machines (8 hours)

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Module 5: Power Converters (6 hours)

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module 6: Electrical Installations (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Text / References:

D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.

D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Course Outcomes:

At the end of this course, students will demonstrate the ability
To understand and analyse basic electric and magnetic circuits.
To study the working principles of electrical machines and power converters. To
introduce the components of low-voltage electrical installations.

BME- 151/251	Engineering Graphics & Design Lab	1L:0T:4P	3 credits
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All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software.

This course is designed to address:

to prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability -

to prepare you to communicate effectively

to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

Proposed Syllabus

Traditional Engineering Graphics: Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics: Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling

BAS 151/251	Physics-1 Lab	0L:0T:3P	1.5 credits
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Any ten experiments (At least 4 from each group)

Group -A

1. To determine the wavelength of sodium light by Newton's Ring experiment
2. To determine the wavelength of different spectral lines mercury light using plane transmission grating.
3. To determine the specific rotation of cane sugar solution using polarimeter.
4. To determine the focal length of the combinations of two lenses separated by a distance and verify the formula for the focal length of the combination of two lenses separated by a distance and verify the formula for the focal length of combination lenses.
5. To measure attenuation in a optical fiber.
6. To determine the wavelength of He-Ne laser light using single slit diffraction
7. To study the polarization of light using He-Ne laser light
8. To determine the wavelength of sodium light with the help of Fresnel's bi- prism.
9. To determine the coefficient of viscosity of a given liquid.
10. To determine the value of acceleration due to gravity (g) using compound pendulum.

Group -B

1. To determine the energy band gap of a given semiconductor material
2. To study Hall effect and determine Hall coefficient. Carrier density and mobility of a given semiconductor material using Hall effect set up.
3. To determine the variation of magnetic field with the distance along the axes of a current carrying coil and estimate the radius of the coil.
4. To verify Stefan's law by electric method
5. To determine resistance per unit length and specific resistance of a given resistance using Carey Foater Bridge.
6. To study the resonance condition of a series LCR circuit
7. To determine the electrochemical equivalent (ECE) of Copper.
8. To calibrate the given ammeter and voltmeter by potentiometer.
9. To draw hysteresis (B-H Curve) of a specimen in the form of a transformer and to determine its hysteresis loss.
10. To measure high resistance by leakage method.

BEEE- 151/251	Electrical Engineering Lab	0L:0T:2P	2 credits
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List of Laboratory Experiments/Demonstrations:

Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.

Transformers: Observation of the no-load current waveform on an oscilloscope (non- sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.

Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding- slip ring arrangement) and single-phase induction machine. Torque Speed Characteristic of separately excited dc motor.

Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.

Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.

Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Laboratory Outcomes: The students are expected to

Get an exposure to common electrical components and their ratings. Make electrical connections by wires of appropriate ratings.

Understand the usage of common electrical measuring instruments.

Understand the basic characteristics of transformers and electrical machines. Get an exposure to the working of power electronic converters.

B.TECH. (MECHANICAL ENGINEERING)

SECOND SEMESTER

BAS-102/202	CHEMISTRY-1	HOUR	CREDITS
	(Concept of chemistry in engineering)	3L:1T:0P	4

(i) Atomic and molecular structure (12 lectures)

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

(ii) Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

(iii) Intermolecular forces and potential energy surfaces (4 lectures)

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H₃, H₂F and HCN and trajectories on these surfaces.

(iv) Use of free energy in chemical equilibria (6 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Waterchemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

(v) Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

(vi) Stereochemistry (4 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

(vii) Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Outcomes

This course applies the principles studied in Chemistry – I to understand the structures of different types of molecules in various environments. The students will be able distinguish between the structures, reactions and synthesis of polymers, surfactants, lubricants, metals, alloys, colloids and nanomaterials. New analytical techniques will be compared with the classical methods that use gravimetric and volumetric analysis. Chemical analysis of corrosion will be made. Green chemistry, environmental chemistry and non-conventional energy sources will be assessed in the present context.

Books:

University chemistry, by B. H. Mahan

Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane

Fundamentals of Molecular Spectroscopy, by C. N. Banwell

Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

Physical Chemistry, by P. W. Atkins

Organic Chemistry: Structure and Function by K. P. C. Vollhardt and N. E. Schore, 5th Edition <http://bcs.whfreeman.com/vollhardtschore5e/default.asp>

BAS-203	MATHEMATICS II	HOUR	CREDITS
	(Calculus, Ordinary Differential Equations and Complex Variable)	3L:1T:0P	4

Detailed contents

Module 1: Multivariable Calculus (Integration): (10 lectures)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Module 2: First order ordinary differential equations: (6 lectures)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p , equations solvable for y , equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders: (8 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation: (8 lectures)

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable – Integration: (8 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Suggested Text/Reference Books

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
- S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
- E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
- E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
- J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

The students will learn:

The mathematical tools needed in evaluating multiple integrals and their usage.

The effective mathematical tools for the solutions of differential equations that model physical processes.

The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

BCSE-151/251	PROGRAMMING FOR PROBLEM SOLVING LAB	HOUR	CREDITS
		3L:0T:0P	3

Unit 1: Introduction to Programming (3 hours)

Introduction to the idea of algorithm; Introduction to Programming (Flow chart/pseudocode); the compilation process, object code and executables, Variables (including data types), Mapping of variables to memory locations, Syntax and logical error

Unit 2: Arithmetic expressions, precedence, Conditional Branching and Loops (10 hours)

Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Unit 3: Arrays (6 hours)

Arrays (1-D, 2-D), Character arrays and Strings.

Unit 4: Basic Algorithms (6 hours)

Searching: Linear and Binary, Basic Sorting Algorithms, Finding roots of equations (two algorithms)

Unit 5: Function and Recursion (10 hours)

Functions (including using built in libraries), Parameter passing, Call by value, Passing Arrays to functions, Call by reference. Introduction to Recursion; Base condition, example programs such as Factorial, Fibonacci series, Quick sort, Ackerman function etc.

Unit 6: Structures and Pointers (5 hrs)

Structures, typedef, Array of structures; notional introduction to pointers including self-referential structures.

Text / References:

- B. Gottfried, "Programming with C", McGraw-Hill Professional, 1996.
- E. Balagurusamy, "Programming in ANSI C", McGraw-Hill Education, 2008.
- B. W. Kernighan and D. M. Ritchie, "The C Programming Language", Prentice Hall of India, 1990.

BHU-251	English	2L:0T:2P	3 credits
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Detailed contents

1. Vocabulary Building

The concept of Word Formation

Root words from foreign languages and their use in English

Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.

Synonyms, antonyms, and standard abbreviations.

Basic Writing Skills

1.Sentence Structures

2.Use of phrases and clauses in sentences 3 Importance of proper punctuation

3.Creating coherence

4.Organizing principles of paragraphs in documents 6 Techniques for writing precisely

Identifying Common Errors in Writing

Subject-verb agreement

Noun-pronoun agreement

Misplaced modifiers

Articles

Prepositions

Redundancies

Clichés

Nature and Style of sensible Writing

1 Describing

2 Defining

3 Classifying

4 Providing examples or evidence

5 Writing introduction and conclusion

Writing Practices

Comprehension

Précis Writing

Essay Writing

Oral Communication

(This unit involves interactive practice sessions in Language Lab)

Listening Comprehension

Pronunciation, Intonation, Stress and Rhythm
Common Everyday Situations: Conversations and Dialogues
Communication at Workplace

Interviews

Formal Presentations

Suggested Readings:

Practical English Usage. Michael Swan. OUP. 1995.

Remedial English Grammar. F.T. Wood. Macmillan. 2007 (iii)
On Writing Well. William Zinsser. Harper Resource Book. 2001

Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.

Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

BME-152/252	WORKSHOP/MANUFACTURING PRACTICES LAB	HOUR	CREDITS
		1L:0T:4P	3

Manufacturing is fundamental to the development of any engineering product. The course on Engineering Workshop Practice is intended to expose engineering students to different types of manufacturing/ fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc. While the actual practice of fabrication techniques is given more weightage, some lectures and video clips available on different methods of manufacturing are also included.

Lectures& videos: (10 hours)

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing Methods (3 lectures)
2. CNC machining, Additive manufacturing (1 lecture)
 - Fitting operations & power tools (1 lecture)
4. Electrical & Electronics (1 lecture)
5. Carpentry (1 lecture)
6. Plastic moulding, glass cutting (1 lecture)
7. Metal casting (1 lecture)
8. Welding (arc welding & gas welding), brazing (1 lecture)

Workshop Practice: (60 hours)

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1. Machine shop - 10 hours
 2. Fitting shop - 8 hours
 3. Carpentry - 6 hours
 4. Electrical & Electronics - 8 hours
 5. Welding shop - 8 hours (Arc welding 4 hrs + gas welding 4 hrs)
 6. Casting - 8 hours
 7. Smithy - 6 hours
 8. Plastic moulding&Glass Cutting - 6 hours

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Chemistry Laboratory (1.5 credits)

Choice of 10-12 experiments from the following
Determination of surface tension and viscosity
Thin layer chromatography

Ion exchange column for removal of hardness of water
Determination of chloride content of water

Colligative properties using freezing point depression
Determination of the rate constant of a reaction

Determination of cell constant and conductance of solutions
Potentiometry - determination of redox potentials and emfs
Synthesis of a polymer/drug

Saponification/acid value of an oil
Chemical analysis of a salt

Lattice structures and packing of spheres
Models of potential energy surfaces

Chemical oscillations- Iodine clock reaction

Determination of the partition coefficient of a substance between two immiscible liquids
Adsorption of acetic acid by charcoal

Use of the capillary viscometers to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

Estimate rate constants of reactions from concentration of reactants/products as a function of time

Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc

Synthesize a small drug molecule and analyze a salt sample

B.TECH. (MECHANICAL ENGINEERING)

THIRD SEMESTER

BAS-303	PHYSICS-1I	HOURL	CREDITS
	(Optics & Waves)	3L:1T:0P	4

Physics

Oscillations, waves and optics

Prerequisites:

Mathematics course on Differential equations
Introduction to Electromagnetic theory

Module 1: Simple harmonic motion, damped and forced simple harmonic oscillator **(7)** Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator

Module 2: Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion **(7)**

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their eigenfrequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves.

Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Module 3: The propagation of light and geometric optics **(10)**

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave.

Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method

Module 4: Wave optics **(6)**

Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer.

Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power

Module 5: Lasers (8)

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO₂), solid-state lasers(ruby,

Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Reference books:

Ian G. Main, Oscillations and waves in physics

H.J. Pain, The physics of vibrations and waves

E. Hecht, Optics

A. Ghatak, Optics

O. Svelto, Principles of Lasers

BAS-301	MATHEMATICS -III	HOUR	CREDITS
	(PDE,PROBABILTY & STATISTICS)	3L:1T:0P	4

Contents:

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables. **(14 hours)**

Probability spaces, conditional probability, independence; Discrete random variables, ~~Independent random variables, the multinomial distribution, Poisson approximation to the~~ binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule. **(12 hours)**

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes. **(12 hours)**

Textbooks/References:

- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
- N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
- S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002

BAS-304	BIOLOGY	HOUR	CREDITS
		3L:0T:0P	3

Module 1. (2 hours)- Introduction

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. (3 hours)- Classification

Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module 3. (4 hours)-Genetics

Purpose: To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences” Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module 4. (4 hours)-Biomolecules

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine
Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5. (4 Hours). Enzymes

Purpose: To convey that without catalysis life would not have existed on earth

Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module 6. (4 hours)- Information Transfer

Purpose: The molecular basis of coding and decoding genetic information is universal. Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. (5 hours). Macromolecular analysis

Purpose: How to analyse biological processes at the reductionist level. Proteins- structure and function. Hierarchy in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. (4 hours)- Metabolism

Purpose: The fundamental principles of energy transactions are the same in physical and biological world.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of K_{eq} and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Module 9. (3 hours)- Microbiology

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

References:

- Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H.
John Wiley and Sons
Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

BECE- 305	Basics Electronic Engineering	3L:1T:0P	4 credits
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Objectives:

To provide an overview of electronic device components to Mechanical engineering students

Contents

Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Digital Electronics Fundamentals : Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Electronic Communication Systems: The elements of communication system, IEEE

frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Text /Reference Books:

Floyd ,” Electronic Devices” Pearson Education 9th edition, 2012.

R.P. Jain , “Modern Digital Electronics”, Tata Mc Graw Hill, 3rd Edition, 2007.

Frenzel, “Communication Electronics: Principles and Applications”, Tata Mc Graw Hill, 3rd Edition, 2001

Course Outcomes:

At the end of this course students will demonstrate the ability to

Understand the principles of semiconductor devices and their applications.

Design an application using Operational amplifier.

Understand the working of timing circuits and oscillators.

Understand logic gates, flip flop as a building block of digital systems.

Learn the basics of Electronic communication system.

BME- 301	ENGINEERING MECHANICS	3L:1T:0P	4 credits
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Objectives:

To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads

To calculate the elastic deformation occurring in various simple geometries for different types of loading

Module 1: Three-dimensional Rotation (4 hours)

Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

Module 2: Kinematics of Rigid Body (6 hours)

Kinematics of rigid bodies: Definition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two- and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

Module 3: Kinetics of Rigid Bodies (5 hours)

Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Definition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

Module 4: Free Body Diagram (1 hour)

Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

Module 5: General Motion (9 hours)

Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.

Module 6: Bending Moment (5 hours)

Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

Module 7: Torsional Motion (2 hours)

Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Module 8: Friction (3 hours)

Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

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Course Outcomes:

After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Text / References:

J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.

BME- 302	Thermodynamics	3L:1T:0P	4 credits
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Objectives:

1. To learn about of I law for reacting systems and heating value of fuels
2. To learn about gas and vapor cycles and their first law and second law efficiencies
3. To understand about the properties of dry and wet air and the principles of psychrometry
4. To learn about gas dynamics of air flow and steam through nozzles
5. To learn the about reciprocating compressors with and without intercooling
6. To analyze the performance of steam turbines

Contents:

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. **(5)**

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy. **(5)**

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart. **(8)**

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. **(5)**

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale. **(5)**

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.**(8)**

Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle. **(4)**

Outcomes:

After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.

They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors

They will be able to understand phenomena occurring in high speed compressible flows

Text Books:

Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.

Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India

Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.

Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd.

B.TECH. (MECHANICAL ENGINEERING)

FOURTH SEMESTER

BME - 401	Applied Thermodynamics	3L:1T:0P	4 credits
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Objectives:

- To learn about gas vapour cycles
- To understand about the properties of dry and wet air and the principles of psychrometry
- To learn about gas dynamics of air flow and steam through nozzles
- To learn the about reciprocating compressors with and without intercooling

Contents:

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.(8)

Vapor power cycles Rankine cycle with superheat, reheat and regeneration,exergy analysis. Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle,effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.(12)

Properties of dry and wet air,use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. (4)

Basicsof compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle,supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser. (8)

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. (5)

Analysis of steam turbines, velocity and pressure compounding of steam turbines (3)

Outcomes:

- After completing this course, the students will get a good understanding of various practical power cycles and heat cycles.
- They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
- They will be able to understand phenomena occurring in high speed compressible flows

Text Books:

Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.

Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India

Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.

Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd

BME- 402	Fluid Mechanics And Fluid Machines	3L:1T:0P	4 credits
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Contents:

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications. **(9)**

Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram. **(9)**

Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis. **(6)**

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps-Reciprocating pump – working principle. **(8)**

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines

turbines.

(8)

Course Outcomes:

Upon completion of this course, students will be able to mathematically analyze simple flow situations

They will be able to evaluate the performance of pumps and turbines.

BME - 403	Strength of Materials	3L:1T:0P	4 credits
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Objectives:

To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
 To calculate the elastic deformation occurring in various simple geometries for different types of loading

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Contents:

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle. **(8)**

Beams and types transverse loading on beams- shear force and bend moment diagrams-Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. **(8)**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.**(8)**

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. **(8)**

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure **(8)**

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Course Outcomes:

After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Text Books:

Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.

R. Subramanian, Strength of Materials, Oxford University Press, 2007.

Ferdinand P. Beer, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata

McGrawHill Publishing Co. Ltd., New Delhi 2005.

BME- 404	Materials Engineering	3L:0T:0P	3 credits
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Objectives:

Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.

To provide a detailed interpretation of equilibrium phase diagrams

Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Contents:

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. **(6)**

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength. **(6)**

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT) **(8)**

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron. **(6)**

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening **(6)**

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys. **(8)**

Course Outcomes:

1. Student will be able to identify crystal structures for various materials and understand the defects in such structures

2. Understand how to tailor material properties of ferrous and non-ferrous alloys
 3. How to quantify mechanical integrity and failure in materials
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Text Books:

W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.

Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.

V. Raghavan, "Material Science and Engineering", Prentice Hall of India Private Limited, 1999.

BME - 405	Instrumentation and Control	3L:1T:0P	4 credits
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Objectives:

- To provide a basic knowledge about measurement systems and their components
- To learn about various sensors used for measurement of mechanical quantities
- To learn about system stability and control
- To integrate the measurement systems with the process for process monitoring and control

Contents:

Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements; Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric; Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers; System models, transfer function and system response, frequency response; Nyquist diagrams and their use. Practical group based project utilizing above concepts.

Course Outcomes:

Upon completion of this course, the students will be able to understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

Text Books:

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200
2. Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999.

BMC- 401	ENVIRONMENTAL SCIENCE	L:T:P	0 credits
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Syllabus

UNIT -1 Definition , Scope & Importance, Need For Public Awareness & Environment definition, Eco system - Balanced ecosystem, Human activities - Food, Shelter, Economic and social Security.

Effects or human activities on environment Agriculture, Housing, Industry, Mining and Transportation activities, Basics of Environmental Impact assessment.& Sustainable Development.

UNIT-II Natural Resources, Water Resources- Availability and Quality aspects. Water borne diseases, Water Induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Material

Cycle – Carbon Nitrogen and sulphur cycles.

Energy - Different types of energy, Electromagnetic 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.

UNIT-III Environmental Pollution and their effects. Water pollution, Land pollution. Noise pollution, Public Health aspects, Air Pollution, Solid waste management, e-waste management Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Effects, Urbanization, Automobile pollution. Acid Rain Ozone Layer depletion, Animal Husbandry

UNIT -1V Environmental Protection- Role of Government, Legal aspects, initiatives by Non-governmental organizations' (NGO), Environmental Education, Women Education,

Books

- 1.Environmental Studies -Benny Joseph-Tata McgrawHiU-200S
2. Environme,H-al Studies- Or. D.I. Manjunath, Pearson Education-2006.
3. Environmental studies- R, Rajagop-illan -Oxford Pubtioti,on • 200S.
4. Text book of Environmental S

B.TECH. (MECHANICAL ENGINEERING)

FIFTH SEMESTER

BME- 501	Heat Transfer	3L:1T:0P	4 credits
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Objectives:

The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.

Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.

The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Contents:

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.(12)

Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection. (8)

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.(8)

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ϵ -NTU methods.(6)

Boiling and Condensation heat transfer, Pool boiling curve (3)

Introduction mass transfer, Similarity between heat and mass transfer (3)

Course Outcomes:

After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer

The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer

The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Text Books:

A. Bejan, Heat Transfer John Wiley, 1993

J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.

F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.

MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002

Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

BME -502	Solid Mechanics	3L:1T:0P	4 credits
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Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Course Contents:

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions

Constitutive equations: Generalized Hooke's law, linear elasticity, Material symmetry;

Boundary Value Problems: concepts of uniqueness and superposition.

Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems.

Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems.

Solutions using potentials. Energy methods. Introduction to plasticity.

Course Outcomes:

Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

Text Books:

G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.

Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.

Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

BME- 503	Manufacturing Processes	3L:0T:0P	3 credits
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Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods

Contents:

Conventional Manufacturing processes:

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. **(5)**

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy. **(4)**

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining. **(8)**

Additive manufacturing: Rapid prototyping and rapid tooling **(3)**

Joining/fastening processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding. **(4)**

Unconventional Machining Processes:

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters **(5)**

Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. **(8)**

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining **(3)**

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products

Text Books:

Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-
Pearson India, 2014

Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and
Systems

Degarmo, Black & Kohser, Materials and Processes in Manufacturing

BME- 504	Kinematics and Theory of Machines	3L:1T:0P	4 credits
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Objectives:

To understand the kinematics and rigid- body dynamics of kinematically driven machine components

To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link

To be able to design some linkage mechanisms and cam systems to generate specified output motion

To understand the kinematics of gear trains

Contents:

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms(8)

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics-

Coincident points- Coriolis component of acceleration- introduction to linkage synthesis-three position graphical synthesis for motion and path generation (8)

Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics(8)

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication-friction clutches- belt and rope drives- friction in brakes (8)

Course Outcomes:

After completing this course, the students can design various types of linkage mechanisms for obtaining specific motion and analyse them for optimal functioning

Text Books:

- Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
 Cleghorn W.L. , Mechanisms of Machines, Oxford University Press, 2005.
 Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009.
 Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

BHU- 501	HUMANITIES-1	3L:0T:0P	3 credits
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Content

Objective: To understand the psychology of the people who work or associated with the industry

INDUSTRIAL PSYCHOLOGY

Unit-I Introduction to Industrial Psychology – Definitions & Scope. Major influences on Industrial Psychology- Scientific Management and Human relations -Hawthorne Experiments. Implications of Industrial Psychology on Modern Industries.

Unit-II Individual in Workplace Motivation and Job satisfaction. Stress management. Organizational culture, Leadership and Group dynamics.

Unit-III Work Environment & Engineering Psychology-fatigue, Monotony, Boredom. Accidents and Safety. Job Analysis, Recruitment, Selection and Interview– Reliability & Validity of recruitment tests.

Unit –IV Performance Management: Training & Development.

Out Come:

With this program one can understand the problem of the people at all the level and able to identify the short commings.

References:

1. Miner J.B. (1992) Industrial/Organizational Psychology. N Y: McGraw Hill.
2. Blum & Naylor (1982) Industrial Psychology. Its Theoretical & Social Foundations CBS Publication.
3. Aamodt, M.G. (2007) Industrial/Organizational Psychology: An Applied Approach (5th edition) Wadsworth/Thompson: Belmont, C.A.
4. Aswathappa K. (2008). Human Resource Management (fifth edition) New Delhi: Tata McGraw Hill.
5. Bisen Vikram & Priya (2008), Industrial Psychology (third edition), New Age International Publishers, New Delhi

BME- 551	Mechanical Engineering Laboratory (Thermal) I	0L:0T:3P	1.5 credits
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Objectives:

To understand the principles and performance characteristics of flow and thermal devices

To know about the measurement of the fluid properties

Contents:

Measurement of Coefficient of Discharge of given Orifice and Venturi meters
Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe
Determination of the performance characteristics of a centrifugal pump
Determination of the performance characteristics of Pelton Wheel
Determination of the performance characteristics of a Francis Turbine
Determination of the performance characteristics of a Kaplan Turbine
Determination of the thermal conductivity and specific heat of given objects
Determination of the calorific value of a given fuel and its flash & fire points
Determination of the p-V diagram and the performance of a 4-stroke diesel engine
Determination of the convective heat transfer coefficient for flow over a heated plate
Determination of the emissivity of a given sample
Determination of the performance characteristics of a vapour compression system

Course Outcomes:

The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid/thermal machinery

BME-552	Project- I	0L:0T:0P (30 hours)	1 credits
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This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

B.TECH. (MECHANICAL ENGINEERING)

SIXTH SEMESTER

BME – 601	Manufacturing Technology	4L:0T:0P	4 credits
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Objectives:

- (i) To provide knowledge on machines and related tools for manufacturing various components.
To understand the relationship between process and system in manufacturing domain.
To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Course Contents:

Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design. (12)

Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and workpiece quality. (16)

Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices. (6)

Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling; Production planning & control: Forecasting models, aggregate production planning, materials requirement planning. Inventory Models: Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT. Simple queuing theory models. (16)

Course Outcomes:

Upon completion of this course, students will be able to the tooling needed for manufacturing, the dimensional accuracy and tolerances of products, assembly of different components and the application of optimization methods in manufacturing.

Text Books:

Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.

Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.

Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

BME- 602	Design of Machine Elements	3L:1T:0P	4 credits
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Objectives:

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through

1. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components
2. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
3. An overview of codes, standards and design guidelines for different elements
4. An appreciation of parameter optimization and design iteration
5. An appreciation of the relationships between component level design and overall machine system design and performance

Course Contents:

Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure), Design of shafts under static and fatigue loadings, Analysis and design of sliding and rolling contact bearings, Design of transmission elements: spur, helical, bevel and worm gears; belt and chain drives, Design of springs: helical compression, tension, torsional and leaf springs, Design of joints: threaded fasteners, pre-loaded bolts and welded joints, Analysis and applications of power screws and couplings, Analysis of clutches and brakes

Course Outcomes:

Upon completion of this course, students will get an overview of the design methodologies employed for the design of various machine components.

Text Books:

Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.

Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.

Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.

Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.

R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

BME- (611-612)	ELECTIVE –II	3L:0T:0P	3 credits
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BME- 611 (Internal Combustion Engines)

CONTENT

Objectives:

To familiarize with the terminology associated with IC engines.

To understand the basics of IC engines.

To understand combustion, and various parameters and variables affecting it in various types of IC engines.

To learn about various systems used in IC engines and the type of IC engine required for various applications

Course Contents: Review of ideal cycles; Details of fuel-air cycles. Combustion in SI and CI engines, Combustion stages, Combustion chambers and Abnormal combustion. Fuel supply systems in SI and CI engines, carburetors, Port fuel injection, Direct injection and Common rail injection. Ignition system, Lubrication system and Cooling system. Testing of IC engines. Engine emissions and control. Advanced IC Engine concepts.

Course Outcomes:

Students who have done this course will have a good idea of the basics of IC engines and how different parameters influence the operational characteristics of IC Engines

Text Books:

Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.

Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.

Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989

Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.

Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", The Goodheart, Wilcox Co. Inc., Illinois, 1996

BME- 612 (Mechatronic Systems)

CONTENT

Description:

To understand the structure of microprocessors and their applications in mechanical devices
To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators
To understand the use of micro-sensors and their applications in various fields

Course Contents:

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and

Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface Sensors and transducers: classification, Development in Transducer technology, Opto-electronics-Shaft encoders, CD Sensors, Vision System, etc.;

Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems;

Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.;

Micromechatronic systems: Microsensors, Microactuators; Micro-fabrication techniques

LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Course Outcomes:

Upon completion of this course, students will get an overview of mechatronics applications and the use of micro-sensors and microprocessors.

Text Books:

Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)

Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education

A Textbook of Mechatronics ,R.K.Rajput, S. Chand & Company Private Limited

Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hal

BME- (621-623)	OPEN ELECTIVE –II (Humanities)	3L:0T:0P	3 credits
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BME- 621 (Microprocessors in Automation)

CONTENT

Objectives:

To introduce the basic concepts of Digital circuits, Microprocessor system and digital controller

Course Contents: Number Systems, codes, digital electronics: Logic Gates, combinational

circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals.

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.

Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255). Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features,

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z-Transform, Digital Filters, Implementation of Digital Algorithm.

Course Outcomes:

Students who have done this course will have a good idea of the use of microprocessors for automation.

Text Books:

Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
 Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd.

Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.
Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).

5) Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall

BME- 622 (Composite Materials)

CONTENT

Objectives:

- To understand the mechanical behaviour of composite materials
- To get an overview of the methods of manufacturing composite materials

Contents:

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke's law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament winding, other manufacturing processes

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies

Course Outcomes:

Upon completion of this course, the students will have an overview of the mechanical behaviour and application of composite materials

Text Books:

- Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
- Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998

BME- 623 (Computer Aided Design)

CONTENT

Objectives:

To provide an overview of how computers can be utilized in mechanical component design

Contents:

Fundamentals of Computer Graphics- Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation

Geometric Modeling- representation of curves, Hermite curves, Bezier curves, B-spline curves, rational curves, Techniques of surface modelling, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, Solid modelling techniques, CSG and B-rep.

Visual realism- hidden line-surface-solid removal algorithms, shading, colouring, computer animation

Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interference checking

CAD standards- Graphical Kernel System (GKS), standards for vexchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., and Communication standards

Course Outcomes:

Upon completion of this course, the students can use computer and CAD software for modelling mechanical components.

Text Books:

- Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co. 2007.
- C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education, 1999.
- W. M. Neumann and R.F. Sproul, Principles of Computer Graphics, McGraw Hill, 1989.
- D. Hearn and M.P Baker, Computer Graphics, Prentice Hall Inc., 1992,

BME -651	Mechanical Engineering Laboratory (Design) II	0L:0T:3P	1.5 credits
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Objectives:

- To understand the measurement of mechanical properties of materials
- To understand the deformation behaviour of materials
- To understand the kinematic and dynamic characteristics of mechanical devices

Contents

Uniaxial tension test on mild steel rod

Torsion test on mild steel rod

Impact test on a metallic specimen

Brinnell and Rockwell hardness tests on metallic specimen

Bending deflection test on beams

Strain measurement using Rosette strain gauge

Microscopic examination of heat-treated and untreated metallic samples

Velocity ratios of simple, compound, epicyclic and differential gear trains

Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms

Cam & follower and motion studies

Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient

Determination of torsional natural frequency of single and double rotor systems-undamped and damped natural frequencies

Course Outcomes:

Students who have undergone the course will be able to understand the measurement of mechanical properties of materials and will be able to characterize the dynamic behavior of mechanical systems

BME- 652	Project- II (OR Summer Internship)	0L:0T:6P (90 hours)	3 credits
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This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

B.TECH. (MECHANICAL ENGINEERING)

SEVENTH SEMESTER

BME-701	Automation in manufacturing	3L:0T:0P	3 credits
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Objectives:

To understand the importance of automation in the of field machine tool based manufacturing

To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC

To understand the basics of product design and the role of manufacturing automation

Course Contents:

Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods; Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC-Adaptive Control

Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies

Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies & industrial applications.

Course Outcomes:

Upon completion of this course, the students will get a comprehensive picture of computer based automation of manufacturing operations

Text Books:

(i) Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall

SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology, 7th edition, Pearson

YoramKoren, Computer control of manufacturing system, 1st edition

Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.

BME- (711-712)	ELECTIVE –III	3L:0T:0P	3 credits
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BME- 711 (Refrigeration and air Conditioning)

CONTENT

Objectives:

To familiarize with the terminology associated with refrigeration systems and air conditioning 2. To understand basic refrigeration processes

To understand the basics of psychrometry and practice of applied psychrometrics

To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components

Course Content:

Classification of refrigeration systems

Advanced vapour compression cycles, Refrigerants and their mixtures: properties and characteristics - Ozone depletion and global warming issues - System components: Compressors, Condensers, Expansion devices and Evaporators -Performance matching of components of refrigeration systems

Advanced sorption refrigeration systems and their components.

Review of Psychrometry and Air-conditioning processes - Comfort air conditioning and Cooling load calculations - Applications of AC systems - Concept of enthalpy potential - Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils.

Course Outcomes:

A student who has done the course will have a good understanding of the working principles of refrigeration and air-conditioning systems.

Text Books:

Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.

Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.

Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.

Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.

BME- 712 (Finite Element Analysis)

CONTENT

Objectives:

To illustrate the principle of mathematical modeling of engineering problems

To introduce the basics and application of Finite Element Method

Contents:

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, and introduction to FE software.

Course Outcomes:

Upon completion of the course, students will understand the FEM formulation and its application to simple structural and thermal problems

Text Books:

Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.

Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.

Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.

Chandraputla&Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

BME- (721-722)	ELECTIVE –IV	3L:0T:0P	3 credits
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BME- 721 (Power Plant Engineering)

CONTENT

Objectives:

To provide an overview of power plants and the associated energy conversion issues

Contents:

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Outcomes:

Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.

Text Books:

Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.

El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998

BME- 722 (Gas Dynamics and Jet Propulsion)

CONTENT

Objectives:

To understand the features of compressible isentropic flows and irreversibilities like shocks.

To provide a basic knowledge of jet and rocket propulsion technologies.

Contents:

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights

Course Outcomes:

Upon completion of this course, the students will be able to apply gas dynamics principles to jet and space propulsion systems

Text Books:

Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.

H.S. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing, 2004.

Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.

Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.

Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

ROE-(001-003)	OPEN ELECTIVE –III	3L:0T:0P	3 credits
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BME-751	Mechanical Engineering Laboratory III (Manufacturing)	0L:0T:3P	1.5 credits
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Objectives:

- To provide an understanding of advanced manufacturing methods.
- To get an idea of the dimensional & form accuracy of products

Contents:

About 12 experiments will be carried out as listed below.

- Taper turning and external thread cutting using lathe
- Contour milling using vertical milling machine
- Spur gear cutting in milling machine
- Measurement of cutting forces in Milling/ Turning process
- CNC part programming
- Drilling of a small hole using wire EDM
- Microprocessor controlled pick & place robot
- Use of Tool Maker's Microscope
- Comparator and sine bar
- Surface finish measurement equipment
- Bore diameter measurement using micrometer and telescopic gauge
- Use of Autocollimator

Course Outcomes:

Upon completion of this course, students will be able to perform some advanced manufacturing operations and also be able to evaluate the accuracy & tolerance of components produced

BME- 752	Project- III	0L:0T:10P	5 credits
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Objectives:

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester

B.TECH. (MECHANICAL ENGINEERING)

EIGHT SEMESTER

BME- (811-812)	ELECTIVE –V	3L:0T:0P	3 credits
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BME- 811 (Principles of Management)

CONTENT

Objectives:

To understand the principles of management and their application to the functioning of an organization

Contents:

Definition of management, science or art, manager vs entrepreneur; Types of managers- managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Course Outcomes:

Upon completion of this course, the students will get a clear understanding of management functions in an organization

Text Books:

- Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.
- Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
- Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.

BME- 812 (Automobile Engineering)

CONTENT

Objectives:

To understand the construction and working principle of various parts of an automobile

Contents:

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition

Capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

Transmission systems, clutch types & construction, gear boxes- manual and automatic gear shift mechanisms, over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

Steering geometry and types of steering gear box, power steering, types of front axle, and types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells

Course Outcomes:

Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.

Text books:

Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.

Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.

Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.

Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998

BME- (821-823)	ELECTIVE –VI	3L:0T:0P	3 credits
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BME- 821 (Design of Transmission Systems)

Content

Objectives:

To learn about the design procedures for mechanical power transmission components

Contents:

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-speed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Course Outcomes:

Upon completing this course the students will be able to design transmission systems for engines and machines.

Text Books:

Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.

Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.

Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001

BME- 822 (Total Quality Management)

Content

Objectives:

To facilitate the understanding of total quality management principles and processes

Contents:

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Course Outcomes:

Upon completion of this course, the students will be able to use the tools and techniques of TQM in manufacturing and service sectors.

Text Books:

Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006.

Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.

Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.

Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

Content**Objectives:**

To understand the energy data from industries and carry out energy audit for energy savings

Contents:

Introduction to energy & power scenario of world, National Energy consumption data, and environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration & Air Conditioning systems, Cooling Towers, DG sets.

Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

Course Outcomes:

Upon completion of this course, the students will be able to perform of energy auditing for the energy consumption of industries.

Text Books:

Witte L.C., Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988..

Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.

Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.

Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanagertraining.com).

BME- (004-006)	OPEN ELECTIVE –IV	3L:0T:0P	3 credits
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BME- 004: Human Resource Developments and Organizational Behavior

Introduction: HR Role and Functions, Concept and Significance of HR, Changing role of HR managers - HR functions and Global Environment, role of a HR Manager.

Human Resources Planning: HR Planning and Recruitment: Planning Process - planning at different levels - Job Analysis - Recruitment and selection processes - Restructuring strategies - Recruitment-Sources of Recruitment-Selection Process Placement and Induction-Retention of Employees

Training and Development : need for skill up gradation - Assessment of training needs - Retraining and Redeployment methods and techniques of training employees and executives - performance appraisal systems.

Performance Management System: Definition, Concepts and Ethics-Different methods of Performance Appraisal- Rating Errors-Competency management. Industrial Relations: Factors influencing industrial relations - State Interventions and Legal Framework - Role of Trade unions - Collective Bargaining - Workers' participation in management.

BOOK: 1. Gary Dessler, Human Resource Management - (8th ed.,) Pearson Education, Delhi

2. Decenzo & Robbins, Personnel / Human Resource Management, 3rd ed., John Wiley & Sons (Pvt.) Ltd. 3. Biswajeet Patanayak, Human Resource Management, PHI, New Delhi 4. Luis R. Gomez, Mejia, Balkin and Cardy, Managing Human Resources PHI, New Delhi.

BME- (007-010)	OPEN ELECTIVE –V	3L:0T:0P	3 credits
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BME- 851	Project- IV	0L:0T:12P	6 credits
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It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.