Your Dreams Our Goal

POORNIMA UNIVERSITY

Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME & SYLLABUS BOOKLET

BATCH 2023-2027

SCHEME & SYLLABUS

BATCH: 2023-27

INDEX

Disclaimer: The scheme, syllabus and other materials published in this booklet may be changed or modified as per the requirement after approval of competent authority. The decision taken by the management of Poornima University will be final and abiding to all.

Student Details

Name of Student:

Name of Program:

Semester: Year: Batch:

Faculty of:

Your Dreams Our Goal

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VISION

To create knowledge based society with scientific temper, team spirit and dignity of labor to face global competitive challenges.

Mission

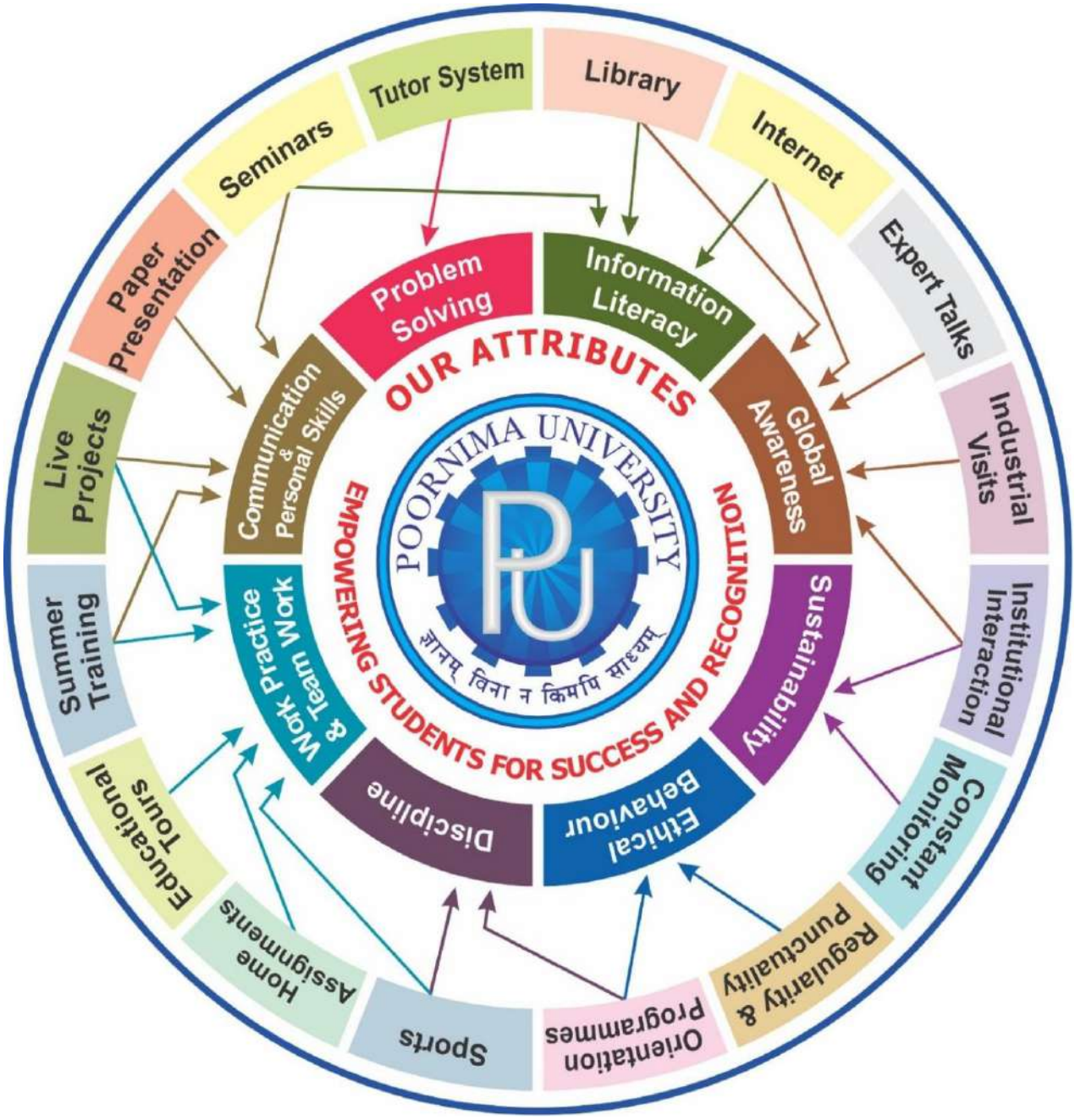
To evolve and develop skill based systems for effective delivery of knowledge so as to equip young professionals with dedication and commitment to excellence in all spheres of life.

Quality Policy

To provide Quality Education through Faculty development, updating of facilities and continual improvement meeting University norms and keeping stake holders satisfied.

Knowledge Wheel

At Poornima, the academic atmosphere is a rare blend of modern technical as well as soft skills and traditional systems of learning processes.



About Program and Program Outcomes (PO):

Title of the Programme: Bachelor of Technology (B. Tech.)

Nature of the Programme: B. Tech. is four year full-time programme.

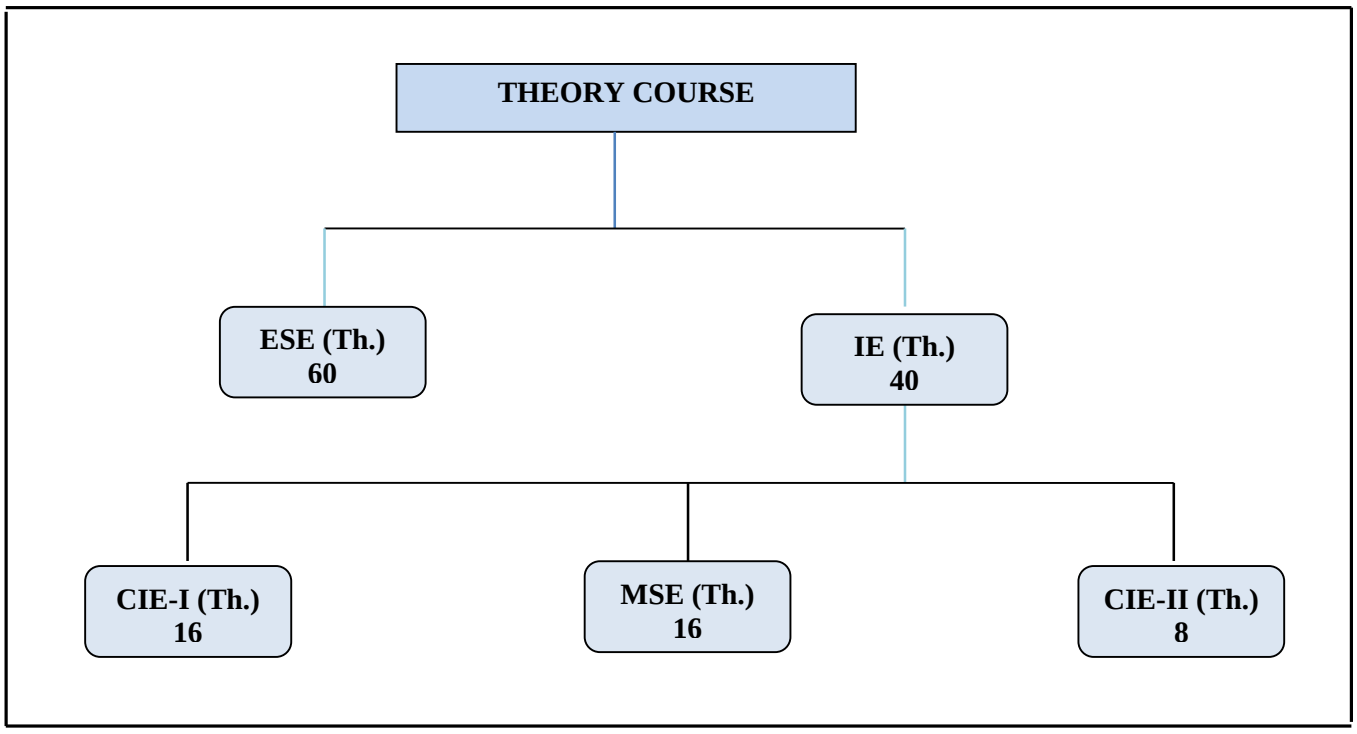
Program Outcomes (PO) :

Engineering Graduates will be able to:

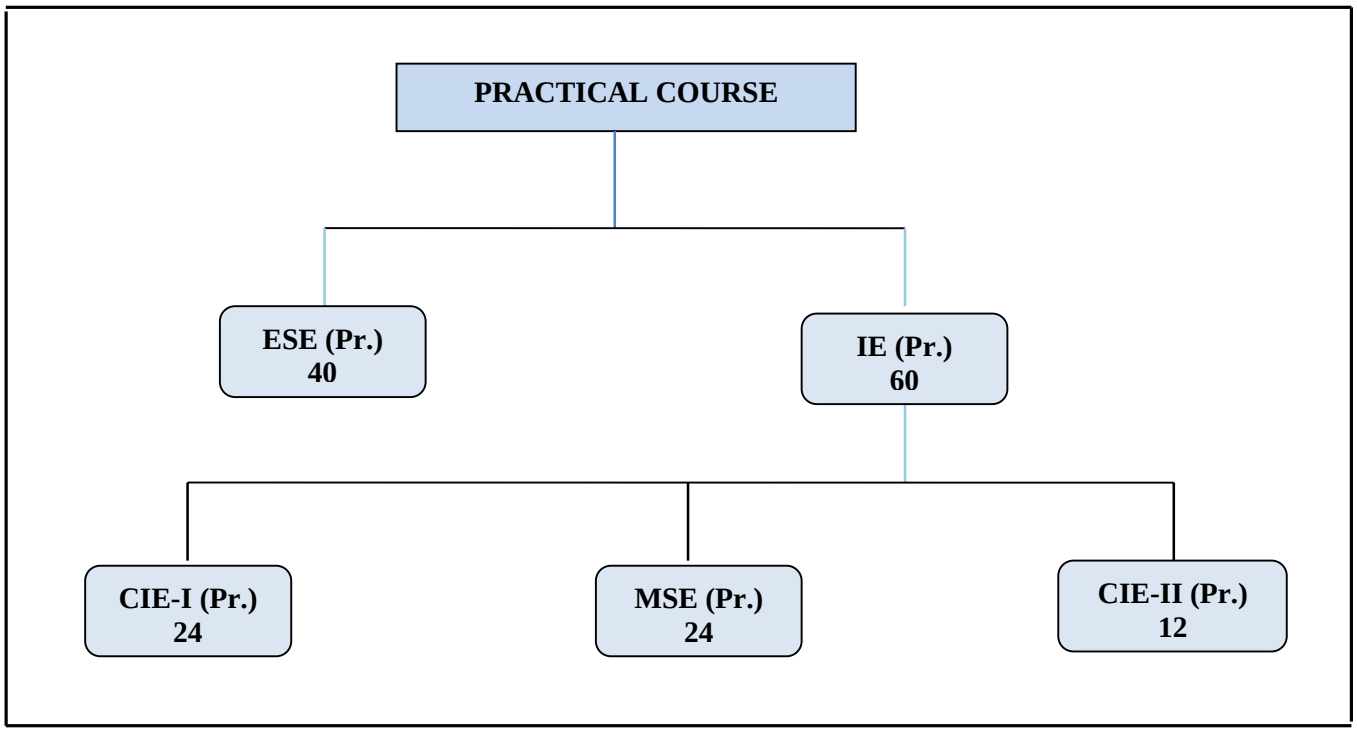
1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **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.
4. **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.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **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.
7. **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.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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.
12. **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.

Examination System :

A. Marks Distribution of Theory Course:



B. Marks Distribution of Practical Course :



Th.: Theory, Pr.: Practical, **ESE:** End Semester Examination, **MSE:** Mid Semester Examination, **CIE:** Continuous Internal Evaluation.

CO Wise Marks Distribution:

Exam Entity	Theory Subject		Practical/ Studio Subject	
	Maximum Marks	CO to be Covered	CO to be Covered	Maximum Marks

CIE-I	16 (8 + 8)	1 & 2	1 & 2	24 (12 + 12)
MSE	16 (8 + 8)	3 & 4	3 & 4	24 (12 + 12)
CIE-II (Activity/ Assignment)	8 (8)	5	5	12 (12)
ESE	60	-	-	40
TOTAL	100	-	-	100

Minimum Passing Percentage in All Exams:

S No.	Program Name	Minimum Passing Percentage in		
		IE Component	ESE Component	Total Component
1	Course Work for PhD Registration	-	-	**50%**
2	B. Arch.	-	**45%**	**50%**
3	MBA, MCA, M.Des., M.Tech., M.Plan, MHA, MPH, MA	-	**40%**	**40%**
4	B. Tech., B. Des., BVA, BCA, B.Sc., BBA, B.Com., B.A.	-	**35%**	**35%**

SGPA Calculation

$$SGPA = \frac{C_1G_1 + C_2G_2 + \ldots\ldots\ldots + C_nG_n}{C_1 + C_2 + \ldots\ldots + C_n}$$

$$SGPA = \frac{\sum_i C_i \times G_i}{\sum_i C_i}$$

where (as per teaching scheme & syllabus):

C_i is the number of credits of subject i,

G_i is the Grade Point for the subject I and i = 1 to n,

n = number of subjects in a course in the semester

CGPA Calculation

$$CGPA = \frac{C_1G_1 + C_2G_2 + \ldots\ldots\ldots + C_nG_n}{C_1 + C_2 + \ldots\ldots + C_n}$$

$$CGPA = \frac{\sum_i C_i \times G_i}{\sum_i C_i}$$

where (as per teaching scheme & syllabus):

C_i is the number of credits of subject i,

G_i is the Grade Point for the subject I and i = 1 to n,

n = number of subjects in a course of all the semesters up to which CGPA is computed

Grading Table:

Applicable for B.Arch. & Ph.D. Courses

Academic Performance	Grade	Grade Point	Marks Range (in %)
Outstanding	O	10	90≤ x ≤100
Excellent	A+	9	80≤ x <90
Very Good	A	8	70≤ x <80
Good	B+	7	60≤ x <70
Above Average	B	6	50≤ x <60
Fail	F	0	x <50
Absent	Ab	0	Absent

Applicable for All Courses except B.Arch. & Ph.D.

Academic Performance	Grade	Grade Point	Marks Range (in %)
Outstanding	O	10	90≤ x ≤100
Excellent	A+	9	80≤ x <90
Very Good	A	8	70≤ x <80
Good	B+	7	60≤ x <70
Above Average	B	6	50≤ x <60
Average	C	5	40≤ x <50
Pass	P	4	35≤ x <40
Fail	F	0	x <35
Absent	Ab	0	Absent

CGPA to percentage conversion rule:

Equivalent % of Marks in the Program = ***CGPA*** ***10**

Award of Class

CGPA	Percentage	Equivalent Division
7.50 ≤ CGPA	75% or more	First Division with Distinction
6.00 ≤ CGPA < 7.50	60% ≤ x <75%	First Division
5.00 ≤ CGPA < 6.00	50% ≤ x <60%	Second Division
4.00 ≤ CGPA < 5.00	40% ≤ x < 50%	Pass Class

Guidelines for Massive Open Online Courses (MOOCs)

(Session 2023-24)

Poornima University, in its never ending endeavor to equip students with best-of-class learning and knowledge, has undertaken to include MOOC courses as part of its credit scheme from session 2023-24 onwards. The objective behind this is to enable students to study courses designed by the best teachers in the country and to scale their knowledge base with the rest of learners from the nation. The MOOCs which are included under this scheme is can be chosen from SWAYAM and NPTEL.

1. Introduction of MOOCs: SWAYAM and NPTEL

About SWAYAM:

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through a platform that facilitates hosting of all the courses, taught in classrooms to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to any learner. However learners wanting a SWAYAM certificate should register for the final proctored exams that come at a fee and attend in-person at designated centers on specified dates. Eligibility for the certificate will be announced on the course page and learners will get certificates only if this criteria is matched.

The courses hosted on SWAYAM are in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology.

In order to ensure that best quality content is produced and delivered, nine National Coordinators have been appointed. They are:

1. AICTE (All India Council for Technical Education) for self-paced and international courses
2. NPTEL (National Programme on Technology Enhanced Learning) for Engineering
3. UGC (University Grants Commission) for non-technical post-graduation education
4. CEC (Consortium for Educational Communication) for under-graduate education
5. NCERT (National Council of Educational Research and Training) for school education
6. NIOS (National Institute of Open Schooling) for school education
7. IGNOU (Indira Gandhi National Open University) for out-of-school students
8. IIMB (Indian Institute of Management, Bangalore) for management studies
9. NITTTR (National Institute of Technical Teachers Training and Research) for Teacher Training programme

Two types of courses are offered on SWAYAM platform: Credit Courses and Non- Credit Courses. Credit courses are offered for each semester in January and July every year. The list is available on SWAYAM official website: https://onlinecourses.swayam2.ac.in/

About NPTEL:

NPTEL (National Programme on Technology Enhanced Learning), is a joint venture of the IITs and IISc, funded by the Ministry of Education (MoE) Government of India, and was launched in 2003. Initially started as a project to take quality education to all corners of the country, NPTEL now offers close to 600+ courses for certification every semester in about 22

disciplines.

Some highlights:

- Largest online repository in the world of courses in engineering, basic sciences and selected humanities and management subjects
- YouTube channel for NPTEL – most subscribed educational channel, 1.3 billion views and 40+ lakhs subscribers
- More than 56000 hours of video content, transcribed and subtitled
- Most accessed library of peer-reviewed educational content in the world
- Translation of more than 12000 hrs of English transcripts in regional Indian languages

NPTEL Online Certification:

The objective of enabling students obtain certificates for courses is to make students employable in the industry or pursue a suitable higher education programme. Through an online portal, 4, 8, or 12-week online courses, typically on topics relevant to students in all years of higher education along with basic core courses in sciences and humanities with exposure to relevant tools and technologies, are being offered. Enrolment to and learning from these courses is free. Following these online courses, an in-person, proctored certification exam is conducted and a certificate is provided through the participating institutions and industry, as applicable.

Some statistics regarding the open online courses since March 2014 till Dec 2021

Completed courses: 3496;

Enrollments across courses: 1.58 CRORE +

Number of exam registrations: 15.1 LAKH +

All the statistics pertaining to completed courses are available at https://beta.nptel.ac.in/courses. All courses are completely free to enroll and learn from. The certification exam is optional and comes at a fee of Rs 1000/course exam.

2. MOOCs at Poornima University:

MOOCs envelops best in class teaching - learning processes along with meeting the requirements of various courses in terms of quality of teaching and evaluation system. To promote the MOOCs among students of Poornima University, it is decided to consider the credits earned through MOOCs.

(a) Options for MOOCs at Poornima University

(For this document, only those MOOCs will be considered which are available on SWAYAM & NPTEL platforms)

- Credit and Non-credit SWAYAM MOOCs can be opted by anyone, anytime, anywhere and in any language. However, prior-permission of the University Authorities is mandatory if the credits are to be transferred to regular degree.
- In case of credit courses, there are two ways to opt these courses for the purpose of credit transfer to PU system as given below:

OPTION–I: As Open Elective (for batches entered till 2022) / Multidisciplinary Courses (for batches admitted from 2023-24 onwards):

Open Elective (for batches entered till 2022) / Multidisciplinary Courses (for batches admitted from 2023-24 onwards)

are available at University level in offline mode for which relevant booklets are already published. **These courses carries 02 credits.** These category/type of courses (similar/different) are also available as MOOC courses. The respective Deans / HODs shall provide both the options to all the students to either select offline courses or MOOCs as per details given below:

- Deans / HODs shall prepare a list of upto 05 appropriate MOOC courses of 02/03 credits each, well in advance (at-least 15 days prior to commencement of semester) and take approval from the Office of Dean, Academics / Pro-President, PU.
- After approval, the respective Deans / HODs shall circulate a notice to all their respective students so that they can select any one course from the list, the credits **(only 02)** of which will be counted against Open Elective/ Multidisciplinary courses pertaining to that particular semester.
- If the students are not willing to opt for MOOC Open Elective/ Multidisciplinary course, they can proceed with the current offline practice of opting for Multidisciplinary courses.
- The tutor of the class shall monitor the progress (assignments, feedback, any problem etc.) on weekly basis and report to Head/Dean.

OR

OPTION–II: As Major / Minor Courses:

- Deans / HODs shall identify a course of **03 credits** for each semester, well in advance (at-least 15 days prior to commencement of semester) and take approval from the Office of Dean, Academics / Pro-President, PU.
- After approval, the respective Deans / HODs shall circulate a notice to all their respective students citing that the particular course will be conducted through MOOCs only and is compulsory for all respective students. The credits of this course will be counted against Major/Minor courses pertaining to that particular semester.
- The tutor of the class shall monitor the progress (assignments, feedback, any problem etc.) on weekly basis and report to Head/Dean.
- This is to be noted that if Deans / HODs decide to conduct any major/minor course in any semester through MOOCs, no offline course will be conducted against that.

(b) Important points related to MOOCs at Poornima University

- Only one MOOC shall be allowed in a particular semester for the purpose of credit transfer in the beginning.
- No attendance will be taken for MOOC courses.
- Last period of T/T/S shall be taken for MOOC courses which shall be in self-study mode.
- The method of assessments of MOOC such as assignments and examination are completely associated with that particular MOOC and no exam will be conducted by the department as well as by the Examination Cell.
- The respective Dean / HOD must submit the detail of course i.e., code, name and credit of MOOC opted against that particular course in particular semester attached with highlighting in the related examination scheme of syllabus of that semester signed by BOS Convener / HoD and Dean of Faculty to the office of Pro-President before commencement of the classes.
- SWAYAM will award a certificate to all the students passing the examination along with the credit earned. The center of examination for SWAYAM MOOCs will be finalized by SWAYAM. All the responsibility related to registration for MOOCs, timely submission of assignments, examinations etc. will be borne by the students only.
- The list of registered students in MOOC along with name of course will be submitted to the Examination Cell by

the Deans / HoDs before commencement of the classes.

- Any student who would not be able to register/present/clear/pass the MOOC in the stipulated time, it is the choice of the student that he or she may register in next semester (odd or even) with MOOC again or appear as a back exam candidate of the University as per PU norms.
- There will be no provision of re-evaluation of MOOC.
- The scorecard and related certificate of MOOC along with a consolidated list of students with marks of assignment and final exam will be submitted to the examination cell by the concerned Dean / HOD for further process. It is also recommended that alteration/changes/scaling in marks obtained by the students in any MOOC will not be considered.
- The exam registration fee of MOOC up to Max. INR 1000/- will be reimbursed to the student only after successful completion of the course in first attempt and submission of the fee receipt, score-card and certificate of the MOOC to the concerned department within stipulated time after declaration of the results.

NOTE: This is to be noted that the procedure for getting approval from BOS, Faculty Board, Academic Council and BoM is to be followed as per regular process.

Attached Items:

Open Elective Booklet	Annexure-1
Soft Skills Booklet	Annexure-2
Value Added Course Booklet	Annexure-3

POORNIMA UNIVERSITY, JAIPUR
Faculty of Engineering and Technology

Name of Program: B.Tech. in Mechanical Engineering **Duration: 4 Years** **Total Credits: 174**

Teaching Scheme for Batch 2023-27

Semester-I

Course Code	Name of Course	Teaching Scheme				Marks Distribution			Credits
		Lecture (L)	Tutorial (T)	Practical (P)	SH	IE	ESE	Total	
A.		**Major (Core Courses)**							
A.1	**Theory**								
BTXCSA1101	Basic Science for Engineers	3	-	-	1*	40	60	100	3
BTXCCE1102	Fundamental of Computer	3	-	-	1*	40	60	100	3
BTXCME1103/ BTXCEE1104	Basics of Civil Engineering / Basics of Electrical and Electronics	3	-	-	2*	40	60	100	3
BTXCSA1105/ BTXCME2106	Engineering Mathematics / Basic of Mechanical	3	-	-	2*	40	60	100	3
A.2	**Practical**								
BTXCSA1201	Basic Science lab	-	-	2		60	40	100	1
BTXCCE1203	Programming in C Lab	-	-	2		60	40	100	1
BTXCCV1204/ BTXCEE1205	Computer Aided Design (CADD)/ Basics of Electrical and Electronics	-	1	2		60	40	100	1
BTXCME1206/ BTXCME1207	Workshop Practice/Engineering Graphics	-	1	2		60	40	100	1
BTXCCE1208	Exploratory Project	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives**							
B.1	**Theory**								
B.2	**Practical**								
	-								
C		**Multidisciplinary Courses**							
		-	-	-					
D		**Ability Enhancement Courses (AEC)**							
BULCHU1101	English	2	-	-		40	60	100	2
E		**Skill Enhancement Courses (SEC)**							
BULCSE1201	Skill Enhancement Generic Course-I	-	-	2		60	40	100	1
F		**Value Added Courses (VAC)**							
BUVCSA1102	Environmental Studies	2	-	-		40	60	100	2
G		**Summer Internship / Research Project / Dissertation**							
Total		16	2	12					**22**
Total Teaching Hours		**30/36**							

SH: Supporting Hours
***Classes will be conducted fortnightly**

POORNIMA UNIVERSITY, JAIPUR
Faculty of Engineering and Technology

Name of Program: B.Tech. in Mechanical Engineering **Duration: 4 Years** **Total Credits: 174**

Teaching Scheme for Batch 2023-27

Semester-II

Course Code	Name of Course	Teaching Scheme				Marks Distribution			Credits
		Lecture (L)	Tutorial (T)	Practical (P)	SH	IE	ESE	Total	
A.		**Major (Core Courses)**							
A.1	**Theory**								
BTXCCE2101	Python	3	-	-	2*	40	60	100	3
BTXCCV2102/ BTXCEE2103	Basic of Civil Engineering / Basics of Electrical and Electronics Engineering	3	-	-	2*	40	60	100	3
BTXCSA2104/BTXCME2105	Engineering Mathematics / Basic of Mechanical Engineering	3	-	-	2*	40	60	100	3
A.2	**Practical**								
BTXCCE2201	Programming in Python Lab	-	-	2		60	40	100	1
BTXCCV2202/ BTXCEE2203	Computer Aided Design (CADD)/ Basics of Electrical and Electronics Engineering Lab	-	1	2		60	40	100	1
BTXCME1205/BTXCME1206	Workshop Practice/Engineering Graphics	-	1	2		60	40	100	1
BTXCCE1207	Exploratory Project	-	-	2		60	40	100	1
B.		Minor Stream Courses/ **Department Electives**							
B.1	**Theory (Any One)**								
BTXECE2111 BTXECE2112 BTXECE2113 BTXECE2114 BTXECE2115 BTXEME2116	• Introduction to AI&DS • Introduction to Cyber Security • Introduction to Cloud • Introduction to Game Tech. • Digital Electronics • Engineering Mechanics	3	-	-		40	60	100	3
B.2	**Practical**								
C		**Multidisciplinary Courses**							
BTXEBX2109	MOOC Course-I (Human Behavior)	2	0	0		40	60	100	2
D		**Ability Enhancement Courses (AEC)**							
BULCHU2204	Language Lab	0	0	2		60	40	100	1
E		**Skill Enhancement Courses (SEC)**							
BULCSE2201	Skill Enhancement Generic Course-II	-	-	2		60	40	100	1
F		**Value Added Courses (VAC)**							
BUVCPH2102	Health behavior in Communication	2	-	-		40	60	100	2
G		**Summer Internship / Research Project / Dissertation**							
		-	-	-					
Total		16	2	12	6*				**22**
Total Teaching Hours		**30/36**							

SH: Supporting Hours
***Classes will be conducted fortnightly**

POORNIMA UNIVERSITY, JAIPUR
Faculty of Engineering and Technology

Name of Program: B. Tech. Mechanical Engineering **Duration: 4 Years** **Total Credits: 174**

Teaching Scheme for Batch 2023-27

Semester-III

Course Code	Name of Course	Teaching Scheme				Marks Distribution			Credits
		Lecture (L)	Tutorial (T)	Practical (P)	SH	IE	ESE	Total	
A.		**Major (Core Courses)**							
A.1	**Theory**								
BMECSA3101	Engineering Mathematics – II	3	0	0	1*	40	60	100	3
BMECME3102	Mechanics of Solids	3	0	0	1*	40	60	100	3
BMECME3103	Engineering Thermodynamics	3	0	0	1*	40	60	100	3
A.2	**Practical**								
BMECME3201	Material Science Lab	0	0	2		60	40	100	1
BMECME3202	Thermal Engineering Lab	0	0	2		60	40	100	1
BMECME3203	Material Testing Lab	0	0	2		60	40	100	1
BMECME3204	Technical Seminar	0	0	2	2*	60	40	100	1
BMECME3205	Machine Drawing and AutoCAD Lab	0	0	2		60	40	100	1
B.		Minor Stream Courses / **Department Electives**							
B.1	**Theory (Any one)**								
BMEEME3111	Material Science and Engineering	3	0	0	1*	40	60	100	3
BMEEME3112	Operation Management								
BMEEME3113	Smart Technologies for Industry 4.0								
B.2	**Practical**								
	-								
C		**Multidisciplinary Courses**							
BMEEBX3109	MOOC Course-II(Principle of Human Resource Management)	2	0	0					2
D		**Ability Enhancement Courses (AEC)**							
BULCHU3106	Interpersonal Communication & Grooming	0	0	2		40	60	100	2
E		**Skill Enhancement Courses (SEC)**							
BULCSE3201	Skill Enhancement Generic Course-III	0	0	2		60	40	100	1
F		**Value Added Courses (VAC)**							
BUVCCE3101	Digital Marketing	2	0	0		40	60	100	2
G		**Summer Internship / Research Project / Dissertation**							
	-	16		14	6*				**24**
Total Teaching Hours		**30/36**							

SH: Supporting Hours
***Classes will be conducted fortnightly**

	POORNIMA UNIVERSITY, JAIPUR Faculty of Engineering and Technology								
	Name of Program: B.Tech. in Mechanical Engineering Duration: 4 Years Total Credits: 174								
	Teaching Scheme for Batch 2023-27								
	Semester-IV								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
BMECME4101	Theory of Machines	3	1	0	1*	40	60	100	4
BMECME4102	Mechatronics	3	0	0	1*	40	60	100	3
BMECME4103	Manufacturing Process	3	0	0		40	60	100	3
BMECME4104	Fluid Mechanics and Fluid Machines	3	0	0	1*	40	60	100	3
A.2	**Practical**								
BMECME4201	Theory of Machines Lab	0	0	2		60	40	100	1
BMECME4202	Manufacturing Technology Lab – I	0	0	2	1*	60	40	100	1
BMECME4203	Fluid Mechanics and Fluid Machines Lab	0	0	2	1*	60	40	100	1
	Minor Stream Courses / **Department Electives**								
B.1	**Theory**								
BMEEME4111	Non Destructive Evaluation and Testing	3	0	0	1*	40	60	100	3
BMEEME4112	Automation and Robotics								
BMEEME4113	Big Data Analytics for Manufacturing								
B.2	**Practical**								
C		**Multidisciplinary Courses (MC)**							
BMEEBX4109	MOOC Course-III(Fundamentals of Marketing-I)	2	0	0		40	60	100	2
D		**Ability Enhancement Courses (AEC)**							
BULCHU4109	Negotiation Skills & Persuasive Communication	0	0	2		60	40	100	2
E		**Skill Enhancement Courses (SEC)**							
BULCSE4201	Skill Enhancement Generic Course-IV	0	0	2		60	40	100	1
BULCME4202	Skill Enhancement Technical Course-I	0	0	2		60	40	100	2
F		**Value Added Courses (VAC)**							
	-	-	-	-					
G		**Summer Internship / Research Project / Dissertation**							
Total		17	1	12	6*				**26**
Total Teaching Hours		**30/36**							

SH: Supporting Hours
***Classes will be conducted fortnightly**

	POORNIMA UNIVERSITY, JAIPUR Faculty of Engineering and Technology								
	Name of Program: B.Tech. in Mechanical Engineering Duration: 4 years Total Credits: 174								
	Teaching Scheme for Batch 2023-27								
	Semester-V								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
BMECME5101	Design of Machine Elements -I	3	0	0	1*	40	60	100	3
BMECME5102	Manufacturing Science and Technology	3	0	0	1*	40	60	100	3
BMECME5103	Automobile and IC Engine	3	0	0	1*	40	60	100	3
BMECME5104	Heat and Mass Transfer	3	0	0	1*	40	60	100	3
A.2	**Practical**								
BMECME5201	Manufacturing Technology Lab – II	0	0	2		60	40	100	1
BMECME5202	Automobile and IC Engine Lab	0	0	2		60	40	100	1
BMECME5203	Heat Transfer Lab	0	0	2		60	40	100	1
BMECME5204	Industrial Engineering and Robotics Lab	0	0	2		60	40	100	1
B.		Minor Stream Courses **/ Department Electives**							
B.1	**Theory (Any One)**								
BMEEME5111	Industrial Engineering								
BMEEME5112	Sensors and Controls								
BMEEME5113	Product Design and Development	3	0	0	1*	40	60	100	3
B.2	**Practical**								
C		**Multidisciplinary Courses**							
BMEEBX5109	MOOC Course-IV(Fundamental of Marketing –II)	2	0	0					2
D		**Ability Enhancement Courses (AEC)**							
BULCHU5115	Entrepreneurial & Managerial Skills	0	0	2		60	40	100	1
E		**Skill Enhancement Courses (SEC)**							
BULCSE5201	Skill Enhancement Generic Course-V	0	0	2		60	40	100	1
BULCSE5202	Skill Enhancement Generic Course-VI	0	0	2		60	40	100	1
F		**Value Added Courses (VAC)**							
		-	-	-					
G		**Summer Internship / Research Project / Dissertation**							
Total		17	0	14	5*				**24**
Total Teaching Hours		**30/36**							

SH: Supporting Hours
***Classes will be conducted fortnightly**

	POORNIMA UNIVERSITY, JAIPUR Faculty of Engineering and Technology								
	Name of Program: B.Tech. in Mechanical Engineering Duration: 4 Years Total Credits: 174								
	Teaching Scheme for Batch 2023-27								
	Semester-VI								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	Theory								
BMECME6101	MOOC Course (As Described in Annexure-II)	3	0	0		40	60	100	3
A.2	Practical								
BMECME6201	Industrial Technical Seminar-II	0	0	4		60	40	100	2
B.		**Minor Stream Courses / Department Electives**							
B.1	Theory								
	-								
B.2	Practical								
	-								
C		**Multidisciplinary Courses**							
	-	-	-	-					
D		**Ability Enhancement Courses (AEC)**							
	-	-	-	-					
E		**Skill Enhancement Courses (SEC)**							
	-	-	-	-					
F		**Value Added Courses (VAC)**							
	-	-	-	-					
G		**Summer Internship / Research Project / Dissertation**							
BMECME6401	Internship	0	0	12		40	60	100	6
Total		3	0	16					**11**
Total Teaching Hours		**19**							

SH: Supporting Hours
***Classes will be conducted fortnightly**

	POORNIMA UNIVERSITY, JAIPUR Faculty of Engineering and Technology								
Name of Program: B.Tech. in Mechanical Engineering **Duration: 4 Years** **Total Credits: 174**									
	Teaching Scheme for Batch 2023-27								
	Semester-VII								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
BMECME7101	Design of Machine Element – II	3	1	0	1*	40	60	100	4
BMECME7102	Refrigeration and Air Conditioning	3	0	0	1*	40	60	100	3
BMECME7103	Operation Research	3	0	0		40	60	100	3
BMECME7104	Finite Element Analysis	3	0	0		40	60	100	3
A.2	**Practical**								
BMECME7201	Computer Aided Design Lab-I	0	0	2		60	40	100	1
BMECME7202	Refrigeration and Air Conditioning Lab	0	0	2		60	40	100	1
BMECME7203	Additive Manufacturing and Prototyping Lab	0	0	2	1*	60	40	100	1
BMECME7204	Computational Mechanics Lab	0	0	2		60	40	100	1
BMECME7205	Mechanical Measurement and control	0	0	2		60	40	100	1
B.		Minor Stream Courses**/ Department Electives**							
B.1	**Theory (Any One)**								
BMEEME7111	Total Quality Management	3	0	0		40	60	100	3
BMEEME7112	Unconventional Machining Processes								
BMEEBX7113	Principle of Finance								
B.2	**Practical**								
	-								
C	**Multidisciplinary Courses**								
D	**Ability Enhancement Courses (AEC)**								
		-	-	-					
E		**Skill Enhancement Courses (SEC)**							
	-	-	-	-					
F		**Value Added Courses (VAC)**							
	-	-	-	-					
G		**Summer Internship / Research Project / Dissertation**							
BMECME7301	Minor Project	0	0	4	3*	60	40	100	2
Total		14	2	14	6*				**23**
Total Teaching Hours		**30 / 36**							

SH: Supporting Hours
***Classes will be conducted fortnightly**

	POORNIMA UNIVERSITY, JAIPUR Faculty of Engineering and Technology								
	Name of Program:B.Tech. in Mechanical Engineering Duration: 4 Years Total Credits: 174								
	Teaching Scheme for Batch 2023-27								
	Semester-VIII								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**	**SH**	**IE**	**ESE**	**Total**	
A.	**Major (Core Courses)**								
A.1	**Theory**								
BMECME8101	Ergonomics and Workplace Design	3	0	0	1*	40	60	100	3
BMECME8102	Computer Integrated Manufacturing	3	0	0	1*	40	60	100	3
A.2	**Practical**								
BMECME8201	CNC Programming Lab	0	0	2	1*	60	40	100	1
BMECME8202	Computer Aided Design Lab-II	0	0	2		60	40	100	1
BMECME8203	Programming in MATLAB	0	0	2		60	40	100	1
B.	Minor Stream Courses/**Department Electives**								
B.1	**Theory**								
BMEEME8111	Industrial Internet of Things	3	0	0		40	60	100	3
BMEEME8112	Six Sigma and lean manufacturing								
BMEEME8113	Reliability and Maintenance Engineering								
B.2	**Practical**								
C	**Multidisciplinary Courses**								
		-	-	-					
D	**Ability Enhancement Courses (AEC)**								
		-	-	-					
E	**Skill Enhancement Courses (SEC)**								
		-	-	-					
F	**Value Added Courses (VAC)**								
		-	-	-					
G	**Summer Internship / Research Project / Dissertation**								
BMECME8301	Major Project			20	1*	60	40	100	10
Total		9		26	4*				**22**
Total Teaching Hours		**30/36**							

SH: Supporting Hours
***Classes will be conducted fortnightly**

.

TO balance Discipline Credit or Remaining Hours

- Project Based Learning
- Self-Project

Code: BTXCSA1101 **Basic Science for Engineers** **3 Credits [LTP: 3-0-0]**

COURSE OUTCOMES

The Students will be able

CO1.Point out the basic principles of relativity, twin paradox and energy-mass relations
CO2.Produce coherent sources and phenomenon of interference
CO3To learn about the laser and apply it for suitable applications manufacturing of cement and the chemistry involved in setting and hardening of it.
CO4 To use their knowledge of polymers and its use in industries and daily life.
CO5To develop innovative methods to produce soft water for industrial use and potable water at cheaper cost

A.OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit(Hours)
1.	**Special Theory of Relativity**	7
2.	**Wave Optics**	7
3.	**Laser & Binding Materials**	8
4.	**Polymer**	8
5.	**Water Technology**	6

B.DETAILED SYLLABUS

Unit	Unit Details
1.	**Special Theory of Relativity**
	• Introduction of Unit • Inertial and non-inertial frames of Reference. • Postulates of special theory relativity • Galilean and Lorentz Transformations, Length contraction and Time Dilation. • Relativistic Mass-Energy relation • Conclusion of Unit
2.	**Wave Optics**
	• Introduction of Unit • Interference of light**:** Types of interference, • Coherent source, methods to produce coherent sources with examples. • Newton's Rings: Principle, Construction, working &Applications • Conclusion of Unit
3.	**Laser & Binding Materials**
	• Introduction of Unit • Theory of laser action: Einstein's Coefficients, Components of laser, Threshold conditions for laser action • Theory, Design and Applications of He-Ne Laser • Cement: Composition and Significance of cement • Manufacturing of Portland cement by Rotary Kiln Technology • Chemistry of setting and hardening of cement and role of gypsum • Conclusion of Unit
4.	**Polymer**
	• Introduction of Unit • Classification of Polymers and Types of polymerization • Plastics: Constituents of plastics, Thermosets and Thermoplastics, Preparation, Properties and Uses of Polyethylene, Bakelite, Teflon and Nylon • Elastomers: Natural rubber, Vulcanization, Synthetic rubber- Preparation, Properties and Applications of SBR, Buna-N, Butyl and Neoprene rubber • Conclusion of Unit
5.	**Water Technology**
	• Introduction of Unit **Water**

	• Sources of water, Impurities in water and effect of impurities • Municipal water supply: Requisites of drinking water, Steps involved in purification of water, Sedimentation, Coagulation, Filtration and Disinfection, Break Point Chlorination **Water Analysis** • Hardness of water; Type of hardness, Degree of hardness, Units of hardness, Disadvantages of hard water, Determination of hardness by Complexometric (EDTA) method. • Treatment of hard water: Lime-soda method, Permutit (zeolite) method and Deionization or Demineralization method • Desalination: Reverse osmosis, Electrodialysis • Conclusion of Unit

C.RECOMMENDED STUDY MATERIAL:

Sr. No	Reference Book	Author	Edition	Publication
1.	Fundamental of Optics	Jenkins and While	**4th**	Tata McGraw-Hill
2.	Optics	Ajoy Ghatak	**3rd**	Tata McGraw-Hill
3.	Introduction to special Theory of Relativity	R. Resnick	Latest	Johan Willy Singapore
4.	Engineering Chemistry	P.C. Jain	Latest	Dhanpat Rai&Sons
5.	Engineering Chemistry	S. S. Dara	Latest	S. Chand & Co

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**2**	**1**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**2**	**1**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	2	-	-
CO3	2	-	-
CO4	2	-	-
CO5	2	-	-

Note: On the basis of mapping of COs with POs, this course is related to Employability/Skill Development

Code: BTXCCE1102	Fundamental of Computer	3 Credits [LTP: 3-0-0]

Course Outcomes: -

Students will be able to:

- Learn data types, loops, functions, array, pointers, string, structures and files.
- Develop conditional and iterative statements to write C programs.
- Implement concept of string using array.
- Allocate memory dynamically using pointers.
- Apply C Programming to solve real time problems.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	**Introduction to C Programming**	6
2.	**Decision Making & Looping**	6
3.	**Array and string**	8
4.	**Advance programming in C**	8
5.	**File handling & Additional features**	8

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to C Programming**
	• Introduction of Unit • Introduction to computer-based problem solving, Program design and implementation issues- Flowcharts & Algorithms. • Types of Languages – Machine language, assembly language, high level languages, Assemblers, Compilers, Interpreters. • Overview of C, Data Types, Constants & Variables, Literals, Operators & Expressions • Conclusion &Real Life Application
2.	**Decision Making & Looping**
	• Introduction of Unit • Decision making in C- if statement, if-else statement, Nested if statement, if else if Ladder, Switch case • Loop control in C – for loop, while loop • Control flow in C- break, continue and goto statement. • Conclusion &Real Life Application
3.	**Array and string**
	• Introduction of Unit • Array- 1D array, 2D array • Scope rules- Local & global variables. • Functions-parameter passing call by value and call by reference, calling functions with arrays, command line argument. • String – String in-build functions. • Conclusion of the Unit
4.	**Advance programming in C**
	• Introduction of Unit • Pointers- The & and * operator, pointer expression, assignments, arithmetic, comparison, arrays of pointers, pointers to pointers, initializing pointers, pointers to functions. • Structures- Basics, declaring, referencing structure elements, array of structures, passing structures to functions, structure pointers.

	• Conclusion of the Unit
5.	**File handling & Additional features**
	• Introduction of Unit • File Handling – The file pointer, file accessing functions-fopen, fclose, putc, getc, fprintf, reading and writing into a file • Advance features- storage classes and dynamic memory allocation • C Preprocessor- #define, #include, #undef. • C standard library and header files: Header files, string functions, mathematical functions, Date and Time functions. • Conclusion of the Unit

C. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Letus C, 6th Edition	Yashwant Kanitkar	PBP Publication	Letus C ,6th Edition
2.	The C programming Language	Richie and Kenninghan	BPBPublication,2004	The C programming Language
3.	Programming in ANSI C3rd Edition, 2005	E.Balagurusamy	Tata McGraw Hill	Programming in ANSIC 3rd Edition, 2005
Reference Book				
1.	The C programming Language Richie and Kenninghan PBP Publication,2004			
2.	Programming in ANSI C 3rd Edition, 2005 Balaguruswmy Tata McGraw Hill			
Online Resources				
1.	https://www.programiz.com/c-programming/examples			
2.	https://www.w3resource.com/c-programming-exercises			

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**2**	**1**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**2**	**1**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	2	-	-
CO3	2	-	-
CO4	**3**	-	-
CO5	2	-	-

Code: BTXCCV1103	Basics of Civil Engineering	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES: After Successful completion of the course students will be able to:

CO1	To interpret various aspect, Novel areas and Career Prospects in Civil Engineering
CO2	To learn about the use of different Construction Materials and techniques in Civil Engineering
CO3	To identify the various building components, method of constructions and basic principles.
CO4	To understand types of surveying works required
CO5	To learn about the advancements in Civil Engineering

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Civil Engineering	**8**
2.	Construction Materials and techniques	**8**
3.	Building Construction	**8**
4.	Basic Surveying	**8**
5.	Advancements in Civil Engineering	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Civil Engineering**
	• Introduction • Different disciplines of Civil Engineering, Scope and prospects • Role of a Civil Engineer • Units of measurement, Unit conversion (Length, Area, Volume) • Heritage structures, architecture • Infrastructure Engineering. Sustainability • Automation and Robotics in Construction • Novel areas in Construction industry • Career Prospects in Civil Engineering
2.	**Construction Materials and techniques**
	• Introduction • Stone, Requirements of good building stone, General types of stone used in Construction. • Bricks, Modular and Standard bricks, Characteristics of good brick, Field tests on Bricks, Special bricks –fly ash bricks. • Timber, Structure of timber, General properties and uses of good timber, Use of bamboo in construction • Properties of lime, its types and uses • Asphalt, bitumen and tar used in construction, their properties and uses • Types of Stone Masonry (Rubble masonry, Ashlar Masonry) and Brick Masonry (English bond and Flemish bond).
3.	**Building Construction**
	• Introduction • Classification of Buildings as per National Building Code Group A to I • Types of Constructions- Load Bearing Structure, Framed Structure, Composite Structure • Building Components - Functions of Building Components, Substructure-Foundation, Plinth & Superstructure. • Selection of site for different types of Buildings • Basic principles of building planning.

4.	**Basic Surveying**
	• Introduction • Survey – Principles, purpose and use • Types & Classification of surveying • Instruments used in chain survey: Chains, Tapes, Arrow, Ranging rod, Line ranger, Offset rod, Open cross staff, Optical square • Ranging: Direct and Indirect Ranging • Methods of chaining, obstacles in chaining. • Errors in chain and tape, Numerical based on errors in length due to incorrect length of chain & tape.
5.	**Advancements in Civil Engineering**
	• Introduction • Smart city and it's features • Mass Transportation systems-BRTS, Metro • Rain water harvesting systems, Watershed Management • Green building, Energy efficient building • Development of River fronts • Heritage structures & its conservations • Features of affordable housing.

C. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
1.	Basics of Civil Engineering	S.S. Bhavikatti	Latest	New Age International Publishers
2.	Basic Civil Engineering	B C Punmia, Ashok K Jain, Arun K Jain	Latest	Laxmi Publications
3.	Basic Civil Engineering	G K Hiraska	Latest	Dhanpat Rai Publication
4.	Basic Civil Engineering	Jhonson Victor D and Esther Malini	Latest	Allied Publishers Limited, Madras
5.	Basic Civil Engineering	Arunachalam N	Latest	Pratheeba Publishers, Coimbatore
Important Web Links				
1.	https://nptel.ac.in/courses/105106201			
2.	https://onlinecourses.nptel.ac.in/noc20_ce02/preview			

D. CO-PO Mapping

COs and POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	1	–	–	–	–	–	–	–	–
CO-2	2	3	1	2	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–
CO-4	3	3	1	2	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

COs and PSOs	PSO-1	PSO-2	PSO-3
CO-1	1	–	3
CO-2	2	–	3
CO-3	1	–	3
CO-4	1	–	3
CO-5	2	–	3

Code: BTXCEE1104 **Basics of Electrical and Electronics** **3 Credits [LTP: 3-0-0]**

COURSE OUTCOME

The student will be able to:

- Apply basic electrical concepts, including various circuit analysis techniques and fundamentals of theorem, in practical applications.
- Analyze the fundamentals of AC circuits such as the R.M.S value, average value, active power, reactive power, power factor, form factor, peak factor and their applications.
- Analyze the energy conversion process and fundamentals of rotating and stationary electrical machines with their application in real life.
- Analyze the working of semiconductor devices such as Diode, BJT, UJT, photovoltaic cells, filters and fundamentals of digital electronics.
- Illustrate the concepts of Communication systems and Instrumentation engineering in practical applications.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	**Basic Concepts of Electrical Engineering**	8
2.	**Alternating Quantities and Electrical Installations**	8
3.	**Energy Conversion and Electrical Machines**	7
4.	**Basic Electronics**	8
5.	**Communication Systems and IoT**	8

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Basic Concepts of Electrical Engineering**
	• Introduction of Unit • Basic Concepts: Electric Current, Electromotive Force, Electric Power, Ohm's Law, Basic Circuit Components, Faraday's Law of Electromagnetic Induction. • DC Network Analysis & Theorems: Kirchhoff's Laws, Network Sources, Resistive Networks, Series-Parallel Circuits, Star-Delta Transformation, Node Voltage Method, Mesh Current Method, Super- Position, Thevenin's, Norton's and Maximum Power Transfer Theorems. • Conclusion of Unit
2.	**Alternating Quantities and Electrical Installations**
	• Introduction of Unit • Single Phase AC system: Introduction, Generation of AC Voltages, Root Mean Square and Average Value of Alternating Currents and Voltages, Form Factor, Peak Factor, Power Factor and Quality Factor, Phasor Diagram • Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries. Elementary calculations for energy consumption and savings, battery backup. • Conclusion of Unit
3.	**Energy Conversion and Electrical Machines**
	• Introduction of Unit • Introduction to Energy: Types of Energy, Introduction to Energy Conversion, Sources of Energy (Conventional & Non-Conventional), Energy Scenario in India & Rajasthan. • Rotating Machines: **DC Machines**: Principle of Operation of DC Machine as Motor and Generator, EMF Equation, Applications of DC Machines. **AC Machines:** Principle of Operation of 3-Phase Induction Motor, 3-Phase Synchronous Motor and 3- Phase Synchronous Generator (Alternator), Applications of AC Machines. • Conclusion of Unit
4.	**Basic Electronics**
	• Introduction of Unit • **Semiconductor Devices:** Conduction in Semiconductors, Conduction Properties of Semiconductor Diodes, Behavior of the PN Junction, PN Junction Diode, Zener Diode, LED, Photovoltaic Cell, Rectifiers, L, C, & L-C filters, BJT, UJT, Transistor as an Amplifier. • **Digital Electronics:** Boolean algebra, Binary System, Logic Gates and Their Truth Tables. • Conclusion of Unit

5.	Communication Systems and IoT
	• Introduction of Unit • **Basics of Communication: I**ntroduction, IEEE Spectrum for Communication Systems, Types of Communication, Amplitude and Frequency Modulation. • **Basics of Instrumentation:** Introduction to Transducers, Thermocouple, RTD, Strain Gauges, Load Celland Bimetallic Strip. • **An overview of Internet of Things-**Building blocks of IoT, IoT enabling technologies, Characteristics ofIoT systems and IoT levels, Evolution of the Internet paradigm, Device-to-Device/ Machine-to-Machine Integration • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
1	Electrical and Electronic Technology	Edward Hughes et al,	Latest	Pearson Publication
2	Basic Electrical & Electronics Engineering	V. Jagathesan, K. Vinod Kumar & R. Saravan Kumar	Latest	Wiley India
3	Basic Electrical & Electronics Engineering	Van Valkenburge	Latest	Cengage learning
4	Basic Electrical and Electronics Engineering by,	Muthusubrmaniam	Latest	TMH
5	Basic Electrical & Electronics Engineering	Ravish Singh	Latest	TMH
Important Web Links				
6	https://nptel.ac.in/courses/108108076/			
7	https://nptel.ac.in/courses/117103063/			
8	https://nptel.ac.in/courses/108/101/108101091/			

D. CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**2**	**1**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**2**	**1**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

E. CO-PSO Mapping

COs and PSOs	PSO-1	PSO-2	PSO-3
CO-1	1	–	3
CO-2	2	–	3
CO-3	1	–	3
CO-4	1	–	3
CO-5	2	–	3

Code: BTXCSA1105	Engineering Mathematics	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student would be able:

CO1 To analyze and prove relationships between matrices, rank of matrix and systems of equations, Inverses.

CO2To analyze the basic structure of differential equations, and order and degree of the first order and first degree and its simple applications

CO3 To calculate asymptotes of different curves. They will be able to know fundamentals of tracing the various types of cures and asymptotes play a main role in tracing.

CO4To utilize methods of integration to evaluate volumes and surface of objects and lengths of curves.

CO5To apply vector differentiation, and integration in the scalar and vector fields

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1	Matrices	7
2	Ordinary Differential Equations	8
3	Applications of Differential Calculus	8
4	Integral Calculus	8
5	Introduction Vector Calculus	8

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Matrices**
	• Introduction of Unit • Rank of a Matrix, Normal form of a Matrix • Consistency of systems of linear equations • Eigen Values and Eigen Vectors • Cayley-Hamilton Theorem (without proof) • Conclusion of Unit
2.	**Ordinary Differential Equations**
	• Introduction of Unit • First order and first-degree differential equations-Separable Variables, • Homogenous and reducible to homogenous equation • Linear Equation and reducible to linear form, Exact Equation • Linear differential equations with constant coefficients • Conclusion of Unit
3.	**Applications of Differential Calculus**
	• Introduction of Unit • Asymptotes • Multiple points • Curve tracing for standard Curves (Cartesian Curves only) • Conclusion & Real life applications
4.	**Integral Calculus**
	• Introduction of Unit • Gamma functions and their properties, beta function (only definition) • Double integrals, Double integral by changing into polar form, Areas by Double Integration • Change of order of integration • Conclusion of Unit
5.	**Vector Calculus**
	• Introduction of Unit • Scalar and Vector field • Differentiation and Integration of Vector functions • Gradient, Divergence and Curl, Directional derivatives • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL:

Sr.No	Reference Book	Author	Edition	Publication
1.	Higher Engineering Mathematics	B S Grewal	Latest	Khanna Publications, Delhi,
2.	Higher Engineering Mathematics	Ramana, B.V	Latest	Tata McGraw-Hill.
3	Engineering Mathematics: A Tutorial Approach	Ravish R Singh and M Bhatt	Latest	Tata McGraw-Hill
4	Calculus and Analytical Geometry	Thomas and Finney,	Latest	Narosa Publishing, New Delhi
5	Advanced Engineering Mathematics	Erwin Kreyszig	Latest	John Wiley and Sons
Important Web Links:				
1	https://nptel.ac.in/courses/111105134/			
2	https://nptel.ac.in/courses/122/101/122101001/			
3	https://www.classcentral.com/course/swayam-engineering-mathematics-i-13000			

D. CO-PO Mapping

COs and POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	1	1	–	–	–	–	–	–	–	–
CO-2	3	2	1	2	–	–	–	–	–	–	–	–
CO-3	2	3	2	1	–	–	–	–	–	–	–	–
CO-4	2	2	2	1	–	–	–	–	–	–	–	–
CO-5	2	3	1	1	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

COs and PSOs	PSO-1	PSO-2	PSO-3
CO-1	2	–	–
CO-2	2	–	–
CO-3	1	–	–
CO-4	2	–	–
CO-5	2	–	–

Code: BTXCME1106 **Basic of Mechanical Engineering** **3 Credits [LTP: 3-0-0]**

COURSE OUTCOME

The student would be able to:

CO1 Analyze various metal forming processes
CO2 Illustrate application of IC engine
CO3 Analyze various application of refrigeration and air conditioning
CO4 List out various electrical devise
CO5 Analyze various ergonomics design

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Fundamentals	8
2	Pumps and IC Engines	8
3	Refrigeration and Air Conditioning	7
4	Transmission of Power	8
5	Primary Manufacturing Processes	7

B. DETAILED SYLLABUS

Unit	Unit Details
1	**Primary Manufacturing Processes**
	Metal Casting Process: Introduction to Casting Process, Patterns, Molding, Furnaces. Metal Forming Processes: Introduction to Forging, Rolling, Extrusion, Drawing. Metal Joining Processes: Introduction to various types of Welding, Gas Cutting, Brazing, and Soldering.
2	**IC Engines**
	Classification - SI and CI engine operation - two stroke and four stroke engines - construction - working principle. Theoretical and actual indicator diagrams - calculation of power - efficiency. Valve and port timing diagram - stages of combustion in SI and CI engine - abnormal combustion - combustion chamber.
3	**Refrigeration and Air Conditioning and Aerodynamics**
	Introduction, classification and types of refrigeration systems and air-conditioning. Applications of refrigeration and Air-conditioning. Basics of aerodynamics, Jet propulsion.
4	**Electric Vehicles**
	Architecture of an electric vehicle, essentials and performance of electric vehicles –Traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations.
5	**Ergonomics**
	Introduction, seating dimensions, interior ergonomics, ergonomics system design, seat comfort, suspension seats, split frame seating, back pain reducers, dash board instruments, electronic displays, commercial vehicle cabin ergonomics, mechanical package layout, goods vehicle layout.

C. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
1	Basics of Mechanical Engineering	Punia	Latest	Dhanpat Rai
2	Basics of Mechanical Engineering	R.K. Rajput	Latest	Laxmi
3	Basics of Mechanical Engineering	DS Kumar	Latest	Kataria
Important Web Links				
1	NPTEL			
2	Khan Academy			

D. CO-PO Mapping

COs and POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	1	–	–	–	–	–	–	–	–
CO-2	2	3	1	2	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–
CO-4	3	3	1	2	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

COs and PSOs	PSO-1	PSO-2	PSO-3
CO-1	1	–	3
CO-2	2	–	3
CO-3	1	–	3
CO-4	1	–	3
CO-5	2	–	3

Code: BTXCSA1201 **Basic Science lab** **3 Credits [LTP: 3-0-0]**

COURSE OUTCOMES

Students will be able:

CO1: Learn the concept of interference by the help of Newton's ring & Michelson Interferometer
CO2:Learn the dispersive power of the material of the prism & resolving power of the telescope
CO3:To analyze hardness strength of Ferrous Ammonium sulphate solution and $CuSO_4$ solution.
CO4:To analyze hardness of water
CO5:To handle different instruments & analytical techniques

LIST OF EXPERIMENTS:

1	To determine the wavelength of sodium light by using Newton's Ring.
2	To determine the coherent length and coherent time by using He-Ne-Laser.
3	To measure the numerical aperture of an optical fiber by He-Ne laser.
4	To determine the wavelength of prominent lines of mercury by plane diffraction grating with the help of spectrometer.
5	To specify the specific resistance of a material of a wire by carey Foster Bridge.
6	To determine the dispersive power of a prism for violet, yellow and red colour of mercery light with the help of spectrometer
7	To determine the strength of $CuSO_4$ solution with the help of hypo solution
8	To determine the strength of Ferrous Ammonium sulphate solution with the help of $K_2Cr_2O_7$ solution using diphenyl amine as internal indicator
9	To determine the hardness of water by EDTA method.
10	Synthesis of Bakelite
11	To determine the viscosity of a given lubricating oil by Redwood viscometer
12	To determine the flash and fire point of a given lubricating oil

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**3**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	2	-	-
CO3	3	-	-
CO4	2	-	-
CO5	1	-	-

Note: On the basis of mapping of COs with POs, this course is related to Employability/Skill Development

Code: BTXCCE1202 **Programming in C Lab** **3 Credits [LTP: 3-0-0]**

COURSE OUTCOME: -

Students will be able to:

- Gain concept of functional hierarchical code organization.
- Work with textual information, characters and strings
- Implement file handling concepts
- Implement real time applications using the power of C language features.
- Overcome and solve possible errors during program execution.

A. LIST OF EXPERIMENTS:

1	Given the values of the variables x, y and z, write a program to rotate their values such that x has the value of y, y has the value of z, and z has the value of x
2	Write a program that reads a floating point number and then displays the right-most digit of the integral part of the number.
3	Write a C program to calculate the sum of digits of given number.
4	Program to find largest and smallest number from four given number.
5	Program to find whether a year is leap or not
6	Write a C program in which enter any number by the user and perform the operation of Sum of digits of entered number.
7	Write a C Program to convert Decimal number to Binary number
8	Find the sum of this series upto n terms 1+2+3+4+5+6+……..
9	Program to print Armstrong's numbers from 1 to 100.
10	Write a program to convert years into Minute, Hours, Days, Months, Seconds using switch () statements
11	Write a C menu driven program
12	Write a program to generate the various pattern of numbers
13	Write a C Program to print the reverse of an integer number
14	Write a C program to perform the factorial of given number
15	Write a C program in which a function prime that returns 1 if its argument is a prime and return zero otherwise.
16	Write a C program to calculate factorial of a number using recursion.
17	Write a C program in which enter 10 elements by the user and perform the operation of sorting in ascending order
18	Write a C program to perform to perform Matrix addition and multiplication operations.
19	Write a program to determine the length of the string and find its equivalent ASCII codes.
20	Write a program to delete all the occurrences of the vowels in a given text. Assume that the text length will be of one line
21	Write a program to maintain the library record for 100 books with book name, author's name, and edition, year of publishing and price of the book.

B. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
	Let us C	Yashwant Kanetkar	6th Edition	PBP Publication
	The C programming Language	Richie and Kenninghan	2nd Edition 2004	PBP Publication,2004
	Programming in ANSI C	E Balaguruswamy	3rd Edition, 2005	Tata McGraw Hill
Reference Book				
	The C programming Language by Richie and Kenninghan, PBP Publication,2004			
	Programming in ANSI C 3rd Edition, 2005 by E.Balagurusamy, Tata McGraw Hill			

Online Resources	
	https://www.programiz.com/c-programming/examples
	https://www.w3resource.com/c-programming-exercises

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**3**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	2	-	-
CO3	3	-	-
CO4	2	-	-
CO5	1	-	-

Code: BTXCCV1203 **Computer Aided Design (CADD)** **1 Credits [LTP:0-0-1]**

COURSE OUTCOMES:-

Students will be able to:

CO1 Apply basic concepts to develop construction (drawing) techniques.
CO2 Analyze drawings through editing and plotting techniques
CO3 Apply basic tools to develop outlines in drawings.
CO4 Apply tools to control and manage the drawings in AutoCAD for different purposes
CO5 Create the layout of plans in workspace.

A. LIST OF EXPERIMENTS

1.	• Introduction to AutoCAD and Drawing Tools • Draw Different Shapes using Line, Polyline Circle, and Polygon.
2.	• Draw Different Shapes using Rectangle • Use of Dimensions in Circle, rectangles, Line and other shapes.
3.	• Modify Drawings in AutoCAD using Modification Tools. • Offset and Mirror Different Shapes and Lines.
4.	• Use Trim, Extend &Align, Scale and Strech Command.
5.	• Use of Text, Line, Block and Conversion Tools.
6.	• Introduction to Layers, How to add, Modify layers in layer manager.
7.	• Introduction of Hatch Command in AutoCAD
8.	• Opening and Modifying properties in AutoCAD.
9.	• Layout Design of Building
10.	• 2D Plan of Residential Structure

B. CO-PO Mapping

COs and POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	1	–	–	–	–	–	–	–	–
CO-2	2	3	1	2	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–
CO-4	3	3	1	2	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–

C. CO-PSO Mapping

COs and PSOs	PSO-1	PSO-2	PSO-3
CO-1	1	–	3
CO-2	2	–	3
CO-3	1	–	3
CO-4	1	–	3
CO-5	2	–	3

Code: BTXCEE1204	Basics of Electrical and Electronics lab	1Credits [LTP:0-0-1]

COURSE OUTCOMES:-

Students will be able to:

- Analyze the house wiring connections of various equipment's such as energy meter, ceiling fan, tubelight etc.
- Create the connections of single phase and three phase induction motors.
- Create circuits and connects of various electrical components such as Resistors, Inductors, Capacitors, PN-Diode. Zenger Diode, LED, LCD, etc.
- Analyze the effect of L, C and L-C filters in single phase half wave and full wave bridge rectifier
- Analyze the effect of LC and LC filters in current and power rectifiers

A. LIST OF EXPERIMENTS:

1	Assemble house wiring including earthing for 1-phase energy meter, MCB, ceiling fan, tube light, three pin socket and a lamp operated from two different positions. Basic functional study of components used in house wiring.
2	Prepare the connection of ceiling fan along with the regulator and vary the speed.
3	Prepare the connection of single phase induction motor through 1-Phase Auto-transformer and vary the speed.
4	Prepare the connection of three phase squirrel cage induction motor through 3-Phase Autotransformer and vary the speed.
5	Prepare the connection of Fluorescent Lamp, Sodium Vapour and Halogen Lamp and measure voltage, current and power in the circuit.
6	Identification, testing and application of Resistors, Inductors, Capacitors, PN-Diode. Zenger Diode, LED, LCD, BJT, Photo Diode, Photo Transistor, Analog/Digital Multi- Metres and Function/Signal Generator.
7	Measure the frequency, voltage, current with the help of CRO.
8	Assemble the single phase half wave and full wave bridge rectifier & the analyse effect of L, C and L-C filters in rectifiers.
9	Study the BJT amplifier in common emitter configuration. Measure voltage gain plot gain frequency response and calculate its bandwidth.
10	Verify the truth table of AND, OR, NOT, NOR and NAND gates
11	Prepare the connection of sodium lamp and measure voltage
12	Analyze the effect of LC and LC filters in current and power rectifiers
Virtual Lab	
1	http://vlabs.iitkgp.ernet.in/be/
2	http://em-coep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering

D. CO-PO Mapping

COs and POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	1	–	–	–	–	–	–	–	–
CO-2	2	3	1	2	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–
CO-4	3	3	1	2	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

COs and PSOs	PSO-1	PSO-2	PSO-3
CO-1	1	–	3
CO-2	2	–	3
CO-3	1	–	3
CO-4	1	–	3
CO-5	2	–	3

Code: BTXCME1205	WORKSHOP PRACTICE	1 Credit [LTP: 0-1-2]

COURSE OUTCOMES:-

Students will be able to:

CO1 Create a model of T Lap and T- Briddle Joint through carpentry shop

CO2 Analyze the making of prototype model through foundry shop

CO3 Analyze the difference between gas welding and arc welding and their applications

CO4 Create a model on fitting shop through filling, drilling and tapping operation

CO5 Analyze the difference between forging, moulding and casting

COs and POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	1	–	–	–	–	–	–	–	–
CO-2	2	3	1	2	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–
CO-4	3	3	1	2	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–

A. LIST OF EXPERIMENTS

1	**Carpentry Shop** • Timber, definition, engineering applications, seasoning and preservation • Plywood and ply boards
2	**Foundry Shop** • Moulding Sands, constituents and characteristics • Pattern, definition, materials types, core prints • Role of gate, runner, riser, core and chaplets • Causes and remedies of some common casting defects like blow holes, cavities, inclusions
3	**Welding Shop** • Definition of welding, brazing and soldering processes and their applications • Oxyacetylene gas welding process, equipment and techniques, types of flames and their applications • Manual metal arc welding technique and equipment, AC and DC welding • Electrodes: Constituents and functions of electrode coating, welding positions • Types of welded joints, common welding defects such as cracks, undercutting, slag inclusion and boring
4	**Fitting Shop** • Files, materials and classification.
5	**Smithy Shop** • Forging, forging principle, materials • Operations like drawing, upsetting, bending and forge welding • Use of forged parts

List of Jobs to be made in the Workshop Practice

1.	**Carpentry Shop** 1. T – Lap joint 2. Bridle joint
2.	**Foundry Shop** 3. Mould of any pattern
3.	**Welding Shop** 4. Square butt joint by MMA welding 5. Lap joint by MMA welding
4.	**Machine Shop Practice** 6. Job on lathe with facing operation 7. Job on lathe with one step turning and chamfering operations 8. Job on shaper for finishing two sides of a job
5.	**Fitting Shop**

	9. Finishing of two sides of a square piece by filing 10. Drilling operation on fitted job (two holes) 11. Slotting operation on fitted job 12. Tapping operation on fitted job

COs and PSOs	PSO-1	PSO-2	PSO-3
CO-1	1	–	3
CO-2	2	–	3
CO-3	1	–	3
CO-4	1	–	3
CO-5	2	–	3

Code: BTXCME2106	Engineering Graphics	1 Credit [LTP: 1-0-2]

COURSE OUTCOME: -

Students will be able to:

CO1 Apply the concept of scale and their applications

CO2 Analyze the different applications of conic section and engineering curves and also how to draw on sheet

CO3 Analyze the use of projection and also analyze the difference between first and third angle projection method

CO4 Apply the concepts of sectioning, true section and apparent section and create the sectional views of the engineering components.

CO5 analyze the development of surface and analyze the sheet metal requirement for fabricating a surface.

A. List of Experiments

1.	• Lines, Lettering and Dimension (Sketch Book) • Scales: Representative Fraction, plain scales, diagonal scales, (In drawing sheet 1)
2.	• Conic Sections: Construction of ellipse, parabola and hyperbola by different methods(in drawing sheet) Engineering Curves: Construction of Cycloid, Epicycloids, Hypo-cycloid(in drawing sheet 2)
3.	• Type of Projection, Orthographic projection: first angle and third angle projection (in drawing sheet) • Projection of Points • Projection of Straight lines • Projection of planes: Different positions of plane lamina like: regular polygon, circle of three planes (four problems in drawing sheet) • Projection of Solids: Projection of right and regular polyhedron, cone (four problem in drawing sheet 3)
4.	• Orthographic Projections (3 Problems in drawing sheet 4)
5.	• Sectional Views (2 Problems) and Riveted joints, lap joints, butt joints, chain riveting (drawing sheet 5)

B. CO-PO Mapping

COs and POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	1	–	–	–	–	–	–	–	–
CO-2	2	3	1	2	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–
CO-4	3	3	1	2	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–

C. CO-PSO Mapping

COs and PSOs	PSO-1	PSO-2	PSO-3
CO-1	1	–	3
CO-2	2	–	3
CO-3	1	–	3
CO-4	1	–	3
CO-5	2	–	3

Code: BTXCEE1207	Exploratory Project	1 Credits [LTP: 0-0-1]

LAB OUTCOMES: After Successful completion of the lab students will be able to-

LO1 Predict a problem of current relevance to society

LO2 Formulate the problem and identify suitable modelling paradigm

LO3 Categorize the problem and identify the solution methodology

LO4 Simulate and design systems using various modern tools

LO5 Validate the results and prepare a project report

GUIDELINES:

1. The Project group must complete project in all respect (assembly, testing, fabrication, tabulation, test result etc.)
2. The group should maintain a log book of activities. It should have entries related to the worked one, problems faced, solution evolved etc., duly signed by guide.
3. The guides should regularly monitor the progress of the project work.
4. The project work along with project report should be submitted as part of term work in first term on or before the last day of the second term.
5. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.
6. Assessment of the project forward of marks shall be done by the guide and a departmental committee.
7. The guide should be internal examiner for oral examination.
8. The external examiner should be from the related area of the concerned project. He should have experience at degree level / industry.

The evaluation at final oral examination should be done jointly by the internal and external examiner.

Phases:

Project work is divided into the following phases:

Phase I

- Allocation of groups(Max. 4 Members & Min. 2 Members) & guide
- Black board presentation on topics as per the choice & feasibility
- Submission of abstract & synopsis of the project

Phase II

- Procurement of the components
- 2D/3D figure or model
- Paper work like any circuit diagram and tentative cost

Phase III

- Working Model of the project
- Mounting the components
- Final hardware evaluation/presentation
- Submission of the final hardware to the coordinator.

Phase V

- Final report submission (after project exhibition)
- Paper presentation on the selected project in seminars /conferences/journals
- Viva voce

Deadlines of Phases:

The Project will be covered in 13 weeks from starting of semester. The time allocated to each phase is as follow:

Phase -1: Maximum 2 weeks
Phase -2: Maximum 3 weeks
Phase -3: Maximum 6 weeks
Phase- 4: Maximum 2 weeks

Distribution of Marks:-

Total Marks 100

Break up of marks (100)

Performance of Phase 1	:15
Performance of Phase 2	:20
Performance of Phase 3	:20
Performance of Phase 4	:45
Total	:**100**

Note: 1. Performance marks of Phase 1/2/3/4 will be given by Coordinators, Guide and external (if any) on

completion of the respective phase.

2. Presentation and demonstration will be taken by Project Coordinator, Guide.
3. Guide feedback will be collected by Project Coordinator.

Code: BTXCCE2101	Python Programming	3 Credits [LTP: 3-0-0]

COURSE OUTCOME:

Students will be able to:

- Understand the basic terminology used in computer programming to write, compile and debug programs in Python programming language.
- Use different data types to design programs involving decisions, loops, and functions for problem solving
- Apply various object oriented programming
- Handle the exceptions which are raised during the execution of Python scripts
- Implement files and classes in the Python programming environment

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	**Introduction to Python Programming**	07
2.	**Python Operators and Control Flow statements**	09
3.	**Data Structures, Python Functions and Packages**	09
4.	**Object Oriented Programming**	08
5.	**File I/O Handling and Exception Handling**	09

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Python Programming**
	• Introduction to Unit • What is Python, • Uses of Python Programming Language / Python Applications • Features of Python Programming Language • Python-2 and Python-3 differences • Python environment setup — Installation and working of IDE • Running Simple Python scripts to display 'welcome' message. • Python Data Types: Numbers, String, Tuples, Lists, Dictionary. Declaration and use of data types • Python building blocks — Identifiers, Keywords, Indention, Variables, Comments • Conclusion of unit
2.	**Python Operators and Control Flow statements**
	• Introduction to Unit • Basic Operators: Arithmetic, Comparison/ Relational, Assignment, Logical, Bitwise, Membership, Identity operators, Python Operator Precedence • Control Flow: • Conditional Statements (if, if ... else, nested if) • Looping in python (while loop, for loop, nested loops) • Conclusion of Unit
3.	**Data Structures, Python Functions and Packages**
	• Introduction to Unit • Lists, Tuple, Sets, Dictionaries • String and Slicing • Use of Python built • User defined functions and its types • Command-line Arguments • Using standard packages (e.g. math, scipy, Numpy, pandas etc.) • Conclusion of Unit
4.	**Object Oriented Programming**
	• Introduction of Unit • Creating Classes and Objects

	• Inheritance • Method Overloading and Overriding • Data Hiding • Types of Methods : Instance Methods , Static Methods , Class Methods • Accessing attributes , Built-In Class Attributes • Conclusion of Unit
5.	**File I/O Handling andException Handling**
	• Introduction of Unit • Types of File • File Objects, File Built-in Function, File Built-in Methods • File Built-in Attributes • Read/write operations Reading Text • Errors in Python : Compile-Time Errors ,Runtime Errors , Logical Errors • try….except…else, try-finally clause • Regular expressions • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL:

S. No	Text Books:	Author	Edition	Publication
1.	Core Python Programming	Chun, JWesley	2007	Pearson,
2.	Head First Python	Barry,Paul	2010	ORielly,
Reference Book				
1	Learning Python Lutz, Mark O Rielly, 2009			
Online Resources				
1	https://www.learnpython.org/			
2	https://realpython.com/start-here/			
3	https://www.programiz.com/python-programming			

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**3**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	2	-	-
CO3	3	-	-
CO4	2	-	-
CO5	1	-	-

Code: BTXCCE2201	PYTHON PROGRAMMING LAB	1 Credit [LTP: 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Understand why Python is a useful scripting language for developers.

CO2 Identify the key issues in Python code, develop and experiment with python programming.

CO3 Develop problem solving and critical thinking skills in fundamental enable techniques like conditionals and loops.

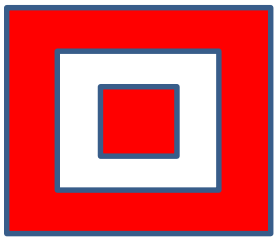
CO4 Construct and explain with structure and concept of different data type like, List and Dictionary.

CO5 Implement read and write data from/to files in Python Develop Python programs step-wise by defining functions with tinker.

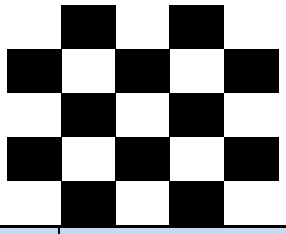
A. List of Programs:

Part A	
	1. Write and run a Python program that outputs the value of each of the following expressions: 5.0/9.0 5.0/9 5/9.0 5/9 9.0/5.0 9.0/5 9/5.0 9/5 Based on your results, what is the rule for arithmetic operators when integers and floating point numbers are used? 2. Write and run a Python program that asks the user for a temperature in Celsius and converts and outputs the temperature in Fahrenheit. (Use the formula given in the example above and solve for tempFin terms of tempC.) 3. Here is an algorithm to print out n! (n factorial) from 0! to 19!: 1. Set f = 1 2. Set n = 0 3. Repeat the following 20 times: a. Output n, "! = ", f b. Add 1 to n c. Multiply f by n Using a for loop, write and run a Python program for this algorithm. 4. Modify the program above using a `while` loop so it prints out all of the factorial values that are less than 1 billion. 5. Modify the first program so it finds the minimum in the array instead of the maximum. 6. (Harder) Modify the first program so that it finds the **index** of the maximum in the array rather than the maximum itself.
Part B	

7. Modify the bubble sort program so it implements the improvements discussed in class. (HINT: To exit the main loop if the array is already sorted, simply change the loop variable to equal the last value so the loop ends early.)
8. Draw the Target symbol (a set of concentric Squares, alternating red and white) in a graphics window that is 200 pixels wide by 200 pixels high. Hint: Draw the largest circle first in red, then draw the next smaller circle in white, then draw the next smaller circle in red. Graphical objects drawn later appear "on top of" graphical objects drawn earlier.



9. Try entering the following literal values at the prompt. (Hit ENTER after each)
   -5
   -4.2
   4.5
   4.14
   0.90
   Something odd should occur. *Describe it on paper.*
10. Create a 5 X 5 rectangle whose top left corner is at (*row**5, *col**5). (Where is the bottom right corner?) If the sum of the *row* and *col* numbers is even, set the fill color of the rectangle to white, otherwise set it to black. Then draw the rectangle.



S. No	Text Books:	Author	Edition	Publication
1.	Core Python Programming	Chun, JWesley	2007	Pear son,
2.	Head First Python	Barry,Paul	2010	ORielly,
Reference Book				
1	Learning Python Lutz, Mark O Rielly, 2009			
Online Resources				
1	https://www.learnpython.org/			
2	https://realpython.com/start-here/			
3	https://www.programiz.com/python-programming			

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	-	2	-	-	-	-	-
CO2	2	3	3	1	-	-	2	-	-	-	-	-
CO3	3	2	2	3	-	-	2	-	-	-	-	-

CO4	**2**	**1**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	**PSO2**	**PSO3**
CO1	3	-	**3**
CO2	2	-	**3**
CO3	3	-	**3**
CO4	2	-	**3**
CO5	1	-	**3**

Code: BTXECE2111	Introduction to Artificial Intelligence	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

Students will be able to:

- Analyze various agents in AI
- Apply Search techniques to solve problem
- Solve the Constraint Satisfaction Problems using AI methods
- Implement Adversarial Search in Game Playing
- Solve real world problems using AI techniques

A. OUTLINE OF THE COURSE

Unit No.	Title of The Unit	Time required for the Unit (Hours)
1.	**Introduction to Artificial Intelligence**	07
2.	**Problem solving by Search**	08
3.	**Constraint Satisfaction Problems**	07
4.	**Software Agents**	07
5.	**AI applications**	07

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Artificial Intelligence**
	• Introduction to Artificial Intelligence • Definition of Artificial Intelligence • A brief history of Artificial Intelligence • Why do we study AI? • What is AI? • Views of AI: Acting Humanly, Thinking Humanly, Thinking Rationally and Acting Rationally • Areas of AI • Agents and environments • PEAS (Performance measure, Environment, Actuators, Sensors) • Environment types • Agent types: Simple reflex agents, Model-based reflex agents, Goal-based agents and Utility-based agents • Examples of Agent • Conclusion of the Unit
2.	**Problem solving by Search**
	• Introduction of Unit • Problem-solving agents • Problem formulation • Example problems: 8-Puzzle problem and 8-queens problem • Basic search algorithms • Un-informed search strategies: Breadth-first search, Depth-first search, Depth-limited search, Uniform-cost search and Iterative deepening search • Informed Search Algorithms: Best-first search, Greedy best-first search, A* search, Hill-climbing search, and Genetic algorithms • Conclusion of the Unit
3.	**Constraint Satisfaction Problems**
	• Introduction to Constraint Satisfaction Problems (CSP) • Why do we need to consider CSPs? • Constraint Propagation • CSP Vs Search problems • Real-world CSPs • Finite vs. Infinite CSP

	• CSP as a Search Problem : Backtracking search for CSPs, Forward checking for CSPs and Local search for CSPs • Conclusion of the Unit
4.	**Adversarial Search and Game Playing**
	• Introduction to Adversarial Search and Game Playing • Games: Definition, Search vs. Games and Game Tree • Optimal decisions in Games: Mini max algorithm and α-β pruning with example • Imperfect, real-time decisions • Partially Observable Games • State-of-the-Art Game Programs: Chess on Deep Blue, Chess on standard PCs, Checkers on Chinook and Backgammon: TD-Gammon • Conclusion of the Unit
5.	**AI Applications**
	• Introduction of Unit • Language Models • Information Retrieval, Extraction • Natural Language Processing • Machine Translation • Speech Recognition • Expert system: Introduction, phases, architecture, Expert system Vs Traditional system • Robot, Hardware , Planning, Moving • Conclusion of the Unit

C. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Artificial Intelligence: A Modern Approach	S. Russell and P. Norvig	Third Edition	Prentice Hall
2.	Prolog: Programming for Artificial Intelligence	I. Bratko	Fourth edition	Addison-Wesley Educational Publishers Inc
Reference Book				
1.	Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, M. Tim Jones.			
2.	The Quest for Artificial Intelligence, Cambridge University Press, Nils J. Nilsson.			
3.	Programming in Prolog: Using the ISO Standard, Fifth Edition, Springer, William F. Clocksin and Christopher S. Mellish.			
4.	Multi Agent Systems, Second Edition, MIT Press, Gerhard Weiss.			
5.	Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, David L. Poole and Alan K. Mackworth.			
Online Resources				
1.	https://onlinecourses.nptel.ac.in/noc21_ge20/preview			
2.	https://www.coursera.org/learn/introduction-to-ai			
3.	https://www.javatpoint.com/artificial-intelligence-tutorial			

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**2**	**2**	**-**		**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**3**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

CO3	**3**	**2**	**2**	**3**	**2**	**-**		**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	**PSO2**	**PSO3**
CO1	3	-	-
CO2	2	-	-
CO3	3	-	-
CO4	2	-	-
CO5	1	-	-

Code: BTXECE2112	INTRODUCTION TO CYBER SECURITY	3 Credit [LTP: 3-0-0]

COURSE OUTCOME

Students will be able to:

- Know basic concepts and importance of information security and cryptography.
- Recognize the business need for information security.
- Gain knowledge about advance cryptographic algorithms and Identify security issues and objectives in computer systems and networks.
- Learn about cryptographic key management.
- Know how message digests are used in authentication.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	**Introduction to Information Security**	8
2	**The Need for IT Security – I**	8
3	**Advance Algorithms and Techniques**	8
4	**Key Management**	8
5	**Cryptography in User Authentication**	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Information Security**
	● Introduction of Unit ● Definition of Information Security, Evolution of Information Security; Basics Principles of Information Security; Critical Concepts of Information Security; Components of the Information System ● Overview of Cryptography (What is Cryptography, Principles of Cryptography Techniques) ● Understanding Mono-Alphabet Substitution Cryptographic Algorithms (Caesar Cipher, Stream Cipher) ● Understanding Multi-Alphabet Substitution Cryptographic Algorithms (Simple substitution, Polyalphabetic substitution) ● Conclusion of the Unit
2.	**The Need for IT Security – I**
	● Introduction of Unit ● Business Needs-Protecting the functionality ● Enabling the safe operations ● Protecting the data, safe guarding the technology assets ● Conclusion of the Unit
3.	**Advance Algorithms and Techniques**
	● Introduction of Unit ● Understanding Birthday Attack (What is Birthday Paradox, how to avoid it) ● Asymmetric Key Algorithms and types (RSA, Diffie-Hellman key exchange, DSA) ● Conclusion of the Unit Attacks-Malicious Codes, Back Doors, Denial of Service and Distributed Denial of Service, Spoofing, sniffing, Spam, Social Engineering ● Conclusion of the Unit
4.	**Key Management**
	● Introduction of Unit ● The basic functions involved in key management including creation ● Distribution, verification, revocation and destruction, ● Storage, recovery and life span and how these functions affect cryptographic integrity ● Conclusion of the Unit
5.	**Cryptography in User Authentication**
	● Introduction of Unit ● Basics of authentication, tokens, ● Certificate-based and biometric authentication,

	● Extensible authentication protocols, and message digest, Security handshake ● Conclusion of the Unit

C. RECOMMENDED STUDY MATERIAL:

Sr.No	Reference Book	Author	Publication
1	Cryptography and Network Security	Atul Kahate	McGraw Hill India, 2017
2	Cryptography and Network Security	S. Bose	Pearson India , 2016
3	Information security: Principles and Practice	Mark Stamp	John Wiley & Sons, Inc., 2011

Reference Book	
1.	Security in Computing, Fourth Edition, by Charles P. P fleeger, Pearson Education
2.	Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson
3	Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
Online Resources	
1.	https://www.sans.org/cyber-security-courses/introduction-cyber-security/
2.	https://nptel.ac.in/courses/106106129

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**2**	**2**	**-**		**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**3**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**3**	**2**	**-**		**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	2	-	-
CO3	3	-	-
CO4	2	-	-
CO5	1	-	-

Code: BCGCCE1107	INTRODUCTION TO CLOUD COMPUTING	3 Credits [3-0-0]

COURSE OUTCOME:
Students will be able to:

- Explain the core concepts of the cloud computing paradigm
- Learn the underlying principles of Cloud Technology and various types of cloud Computing architecture and types.
- Learn to evaluate between different cloud solutions offered by various providers based on their merits and demerits.
- Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost.
- Analyze various cloud programming models and apply them to solve problems on the cloud.

A. OUTLINF OF THE COURSE

Unit	Title of the unit	Time required for the Unit (Hours)
1	Introduction	7
2	Cloud Computing Companies and Migrating to Cloud	8
3	Cloud Cost Management and Selection of Cloud Provider	8
4	Governance in the Cloud	8
5	Ten cloud do's and do not's	8

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction**
	• Introduction to Unit • Introduction to Cloud Computing, History and Evolution of Cloud Computing, Types of clouds, Private and Public clouds, Cloud Computing architecture, Cloud computing infrastructure, Merits of Cloud computing, Practical applications of cloud computing, Cloud computing delivery models and services (IaaS, PaaS, SaaS) • Obstacles for cloud technology, Cloud vulnerabilities, Cloud challenges, • Practical applications of cloud computing • Conclusion of the Unit
2.	**Cloud Computing Companies and Migrating to Cloud**
	• Introduction to Unit • Web-based business services, Delivering Business Processes from the Cloud: Business process examples, • Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud, Efficient Steps for migrating to cloud • Risks: Measuring and assessment of risks, Company concerns Risk Mitigation methodology for Cloud computing, Case Studies • Conclusion of the Unit
3.	**Cloud Cost Management and Selection of Cloud Provider**

	● Introduction to Unit ● Assessing the Cloud: software Evaluation, System Testing, Seasonal or peak loading, Cost cutting and cost- benefit analysis, selecting the right scalable application. ● Considerations for selecting cloud solution. Understanding Best Practices used in selection of Cloud service and providers, Clouding the Standards and Best Practices Issue: Interoperability, Portability, Integration, Security, Standards Organizations and Groups associated with Cloud Computing, Commercial and Business Consideration ● Conclusion of the Unit
4.	**Governance in the Cloud**
	● Introduction to Unit ● Industry Standards Organizations and Groups associated with Cloud Computing, Need for IT governance in cloud computing ● Cloud Governance Solution: Access Controls, Financial Controls, Key Management and Encryption, Logging and Auditing, API integration ● Legal Issues: Data Privacy and Security Issues, Cloud Contracting models, Jurisdictional Issues Raised by Virtualization and Data Location, Legal issues in Commercial and Business Considerations ● Conclusion of the Unit
5	**Ten cloud do's and do not's**
	● Introduction to Unit ● Don't be reactive ● do consider the cloud a financial issue ● don't go alone ● do think about your architecture ● don't neglect governance ● don't forget about business purpose ● do make security the centerpiece of your strategy ● don't apply the cloud to everything don't forget about Service Management ● do start with a pilot project ● Conclusion of the Unit

C. RECOMMENDED STUDY MATERIAL:

Sr.No	Text / Reference Book	Author	Publication
1	Cloud Computing: Principles and Paradigms	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski	John Wiley and Sons Publications, 2011
2	Brief Guide to Cloud Computing	Christopher Barnett	Constable & Robinson Limited, 2010
3	Handbook on Cloud Computing	Borivoje Furht, Armando Escalante, Springer	2010
4	Cloud Computing Theory and Practice	Dan C Marinescu, Elsevier	2013
5	Cloud Computing for Dummies	Judith Hurwitz, Robin Bloor, Marcia Kaufman & Fern Halper	Wiley Publishing, 2010

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**1**	**2**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	1	-	-
CO3	3	-	-
CO4	2	-	-
CO5	2	-	-

Code: BTXECE2114	Introduction to Game Technology	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

Student will able to

- Comprehend the critical importance of Game Technology
- Use learned skills to solve problems of various layouts
- Recognize what is the role each hardware component of a PC plays in games and in making games
- Conduct independent work in entertainment software engineering context.
- Work as a productive member and as part of a team developing larger entertainment software product.

A. OUTLINE OF THE COURSE

Unit No.	Title of The Unit	Time required for the Unit (Hours)
1.	**Introduction to Gaming Technology**	07
2.	**History of Gaming Hardware**	08
3.	**Input devices**	08
4.	**Functions of a GPU in games**	07
5.	**Role of a CPU in games**	07

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Gaming Technology**
	• Introduction of Unit • Basics of processes and models applied in the entertainment software industry • Basics of the game development tools • Introduction to game engines and their functions • Basics of 3D objects • Introduction to game development-related programming problem. • Basics of artificial intelligence in entertainment software engineering context. • Basics of sound engineering • Gamification and Serious games • Basic principles of AR and VR development • Conclusion of unit
2.	**History of Gaming Hardware**
	• Introduction of Unit • Console architecture over the decades • Evolution of input devices in games along with their design changes • analysis of hardware generations of consoles - with a brief overview of Gen 1-4 devices a • A broader look at some significant consoles of Gen 5-8 • Conclusion of Unit
3.	**Input devices**
	• Introduction of Unit • Types and variations of input devices (touch devices, controllers, keyboards, and mice) • How these devices work • Taking multiple types of inputs from these devices • Working on input • Adding support for these devices in your games – • challenges of building/designing an input device (ergonomics, abstraction vs immersion) • Conclusion of Unit
4.	**Functions of a GPU in games**
	• Introduction of Unit • Introduction to graphics APIs • commonly used APIs

	• Working of APIs in GPU Programming) • Shaders • Lighting Techniques (Ray tracing, ray-casting) • Difference between an API and an SDK • Conclusion of Unit
5.	**Role of a CPU in games**
	• Introduction of Unit • multi-threading • hyper-threading, • multi-core CPUs • parallel processing – • Need of multi-threading in games • Function of CPU in games • collision detection • pathfinding, • Realtime object tracking • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL

S. No	**Text Books:**	**Author**	**Edition**	**Publication**
1.	Advanced Game Development with Programmable Graphics Hardware	Alan Watt, Fabio Policarpo	April 2005	A K Peters Ltd
2.	Unity 5 Game Optimization	Chris Dickinson	Nov 2015	O' Riley Media
Reference Book				
3.	Evan Amos, 'The Game Console: A Photographic History from Atari to Xbox', No Starch Press, November 2018, ISBN 978-1593277437			
Online Resources				
4.	https://www.edx.org/learn/game-development tps://learnui.design/			
5.	https://files.eric.ed.gov/fulltext/EJ1090277.pdf			

MAPPING OF COURSE OUTOCMES WITH PROGRAMME OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**1**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**1**	**2**	**1**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**

A. MAPPING OF COURSE OUTOCMES WITH PROGRAMME SPECIFIC OUTCOMES

	PSO1	**PSO2**	**PSO3**
CO1	2	-	-
CO2	2	-	-
CO3	3	-	-
CO4	3	-	-
CO5	1	-	-

Note: On the basis of mapping of COs with POs, this course is related to Employability/Skill Development

Code: BTXECE2115	Digital Electronics	3 Credits [LTP: 3-0-0]

Course Outcomes: -

Students will be able to:

CO1. Verify and interpret truth tables for all logic gates.
CO2. Design of decoders and multiplexer.
CO3. Use various flip-flops in digital circuits
CO4. Apply registers and counters in digital circuits.
CO5. Do conversion from A/D and D/A convertors.

B. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
6.	Number System and Logic Gates	7
7.	Decoders, Multiplexers & De-Multiplexers	6
8.	Flip-Flops	7
9.	Registers And Counters	8
10.	Memories And Converters	8

C. DETAILED SYLLABUS

Unit	Unit Details
1.	**Number System and Logic Gates**
	• **Introduction to number systems** – Binary to decimal conversion – Decimal to binary conversion – Octal numbers – Hexadecimal numbers • **Logic gates** – NOT, OR, AND – Universal NAND and NOR gates – EX-OR and EX-NOR gates – DeMorgan's Theorems — 1's complement – 2's complement – Adders (half & full) – Subtractor (half & full). • Conclusion of the Unit
2.	**Decoders, Multiplexers & De-Multiplexers**
	• Introduction of Unit • Basic functions and block diagram of Encoders and decoders. • Basic functions and block diagram of Multiplexers and De-Multiplexers, Different types and ICs. • 4 bit decoder circuits for 7 segment display and other applications. • Conclusion of the Unit.
3.	**Flip-Flops**

	• Introduction of Unit
	  • J-K Flip-Flop
	  • R-S Flip-Flop
	  • D-Type Flip-Flop
	  • T-Type Flip-Flop
	  • Applications of Flip-Flops
	• Conclusion of the Unit

4.	**Registers And Counters**
	• Introduction to Shift Register • Introduction and basic concepts including shift left and shift right. • Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out. • Introduction to Counters (Asynchronous and Synchronous counters) • Binary up/down counters (upto MOD-8) • Ring counter with timing diagram • Conclusion of the Unit
5.	**Memories And Converters**

	• Introduction of Unit • ***Memories*** – ROM, RAM, EPROM, EEPROM – Volatile and non-volatile – Static and dynamic RAM. • **Analog to digital converters** – Parallel Comparator A/D converter – Dual slope converter –Successive approximation method – Counter type converter. • **Digital to analog converters** – Binary weighted D/A converter – R/2R ladder network converter • Conclusion of the Unit

D. RECOMMENDED STUDY MATERIAL

S. No	Text Books:	Author	Edition	Publication
1.	Digital Principles and Applications	Donald P Leach, Malvino	-	McGraw Hill
2.	Modern Digital Electronics	RP Jain	-	Tata McGraw Hill
3.	Digital Fundamentals	Floyd and Jain	-	Pearsons Education
Reference Book				
3.	Digital Electronics by Rajaraman V., Prentice Hall of India, New Delhi			
4.	Digital Electronics and Applications by Malvino Leach, Tata McGraw Hill Education Pvt Ltd, New Delhi			
Online Resources				
3.	https://archive.nptel.ac.in/courses/108/105/108105132/			
4.	https://onlinecourses.nptel.ac.in/noc22_ee55/preview			

MAPPING OF CO VS PO/PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Note: On the basis of mapping of COs with POs, this course is related to Employability/Skill Development

Code: BTXEME2116 ENGINEERING MECHANICS 3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student will be able to:

CO1 Analyze the forces act on a component and method of resolution.
CO2 Evaluate centroid and center of gravity of an object and also analyze how to minimize the effort for lifting a load.
CO3 Evaluate the effect of friction and also evaluate forces with the effect of friction.
CO4 Analyze the conversion of linear motion into angular motion and vice versa.
CO5 Analyze the effect of impact on elastic and non-elastic body.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	**Fundamentals of Mechanics**	**8**
2.	**Machine & Moment of Inertia**	**8**
3.	**Friction & Belt Drive**	**7**
4.	**Dynamics of Particles**	**8**
5.	**Work, Power & Impact**	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Fundamentals of Mechanics**
	• Introduction of Unit • Fundamental laws of mechanics, Principle of transmissibility. • System of forces, Resultant force, Resolution of force. • Moment and Couples, Varignon's Theorem, • Equilibrium, Conditions for equilibrium, Lami's theorem. • Conclusion of Unit
2.	**Machine & Moment of Inertia**
	• Introduction of Unit • Lifting Machines: Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines – System of Pulleys. • Centroid & Moment of Inertia: Location of centroid and center of gravity, Moment of inertia, Parallel axis and perpendicular axis theorem, Radius of gyration, M.I of composite section- I, L, C and H. • Conclusion of Unit
3.	**Friction & Belt Drive**
	• Introduction of Unit • Friction: Types of Friction, Laws of friction, Angle of friction, Angle of repose, Numericals on Ladder. • Belt Drive: Types of belts, Types of belt drives, Velocity ratio, Effect of slip on Velocity ratio, Length of belt, Ratio of tensions and power transmission by flat belt drives. • Conclusion of Unit
4.	**Dynamics of Particles**
	• Introduction of Unit • Kinematics of Particles and Rigid Bodies: Velocity, Acceleration, Types of Motion, Equations of Motion, Rectangular components of velocity and acceleration, Angular velocity and Angular acceleration. • Kinetics of Particles and Rigid Bodies: Newton's laws, Linear Momentum, Equation of motion in rectangular coordinate, Equation of motion in plane for a rigid body, D' Alembert principle. • Conclusion of Unit
5.	**Work, Power & Impact**
	• Introduction of Unit • Work, Energy and Power: Work of a force, weight, Power, Efficiency, Energy, Kinetic energy of rigid body, Principle of work and energy. • Impact: Collision of elastic bodies, types of impact, conservation of momentum, Newton's law of collision. • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
6.	Vector Mechanics for Engineers	Beer and Johnston	Latest	Tata McGraw Hill
7.	Engineering Mechanics	D S Kumar	Latest	S K Kataria& Sons
8.	Engineering Mechanics Statics	Meriam, J. L. & Kraige, L. G	Latest	John Wiley & Son
9.	Engineering Mechanics	S. Ramamruthan	Latest	Dhanpat Rai Pub.
10.	Engineering Mechanics	Shames	Latest	Pearson Education
Important Web Links				
3.	https://nptel.ac.in/courses/112103109/			
4.	https://nptel.ac.in/courses/112106286/			
5.	https://freevideolectures.com/course/2264/engineering-mechanics			

D. CO-PO Mapping

COs and POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	1	–	–	–	–	–	–	–	–
CO-2	2	3	1	2	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–
CO-4	3	3	1	2	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

COs and PSOs	PSO-1	PSO-2	PSO-3
CO-1	1	–	3
CO-2	2	–	3
CO-3	1	–	3
CO-4	1	–	3
CO-5	2	–	3

THIRD SEMESTER

Code: BMECSA3101	ENGINEERING MATHEMATICS - II	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze exact linear differential equation of non-linear with other form of differential equations.CO2 Analyze the techniques of transform in various form of Laplace rules.

CO3 Analyze the techniques of Fourier transform for solutions PDE.

CO4 Analyze the various form of special function in the differentiation equation.

CO5 Apply the concept of probability and data analyses techniques for statistics.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Ordinary Differential Equations	8
2.	Laplace Transform	6
3.	Fourier Transform	7
4.	Special Functions	8
5.	Statistics and Probability	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Ordinary Differential Equations**
	• Introduction of Unit. • Exact Linear Differential Equations of 2nd order • Non linear differential equation of particular form: Equation of the form $d^n y / dx^n = f(x)$ (Introduction Only) • Equation that do not contain x directly. • Equation that do not contain y directly. • Conclusion and Summary of Unit**.**
2.	**Laplace Transform**
	• Introduction of Unit. • Laplace Transform: Advantage and sufficient conditions for existence of Laplace Transform, General Properties of Laplace Transform. • Inverse Laplace Transform, General Properties of Inverse Laplace Transform, Use of partial fractions to find Inverse Laplace Transform. • Solution of Ordinary differential equation with constant coefficients. • Conclusion and Summary of Unit.
3.	**Fourier Transform**
	• Introduction of Unit • Fourier Integral theorem, Fourier Sine & Cosine Integrals. • Fourier Transforms, Fourier Cosine Transforms, Fourier Sine Transform and their inverse. • Application of Fourier Transform in solving Partial Differential Equations • Conclusion and Summary of Unit.
4.	**Special Functions**

	• Introduction of Unit. • Bessel's function of first kind and second kind, simple recurrence relations, orthogonal property. • Legendre's function of first kind (definition only) • Conclusion and Summary of Unit.
5.	**Statistics and Probability**
	• Introduction of Unit • Statistics, Introduction to Mean, Median, Mode, Standard deviation, Variance, Coefficient of variation • Probability, Probability distribution functions, Binomial, Poisson, Normal Distribution • Conclusion and Summary of Unit.

C. RECOMMENDED STUDY MATERIAL:

S. No	Book	Author	Edition	Publication
Reference Books				
1.	Higher Engineering Mathematics	B S Grewal	Latest	Khanna Publications, Delhi,
2.	Higher Engineering Mathematics	Ramana, B.V	Latest	TMH
3.	Engineering Mathematics: A Tutorial Approach	Ravish R Singh and M Bhatt	Latest	TMH
4.	Calculus and Analytical Geometry	Thomas and Finney,	Latest	Narosa Publishing, Delhi
5.	Advanced Engineering Mathematics	Erwin Kreyszig	Latest	John Wiley and Sons
Important Web Links:				
1.	https://nptel.ac.in/courses/111105035/			
2.	https://nptel.ac.in/courses/111105121/			

A. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	2	3	2	2	–	–	–	–	–	–	–	–
CO4	2	2	2	2	–	–	–	–	–	–	–	–
CO5	2	3	2	2	–	–	–	–	–	–	–	–

B. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	3	–	–
CO2	3	–	–
CO3	3	–	–
CO4	2	–	–
CO5	2	–	–

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME3102	MECHANICS OF SOLIDS	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the theory of elasticity, concepts of stress and strain, strength and stiffness, deformations and displacements, strain energy

CO2 Analyze the principle stresses and strains and theory of

failureCO3 Solve the problems related to SFD and BMD

CO4 Evaluate the twisting moment of shaft and buckling of column

CO5 Evaluate the deflection of beam and concept of strain energy

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Simple Stresses & Strains	7
2	Principle Stresses & Theory of Failure	8
3	Shear Force and Bending Moment Diagram	7
4	Torsion in Circular Shafts	7
5	Deflection of Beams and Strain Energy	7

B. DETAILED SYLLABUS

Unit	Unit Details
1	**Simple Stresses & Strains**
	• Introduction of Unit • Concept of stress and strain (linear, lateral, shear and volumetric), Hook'slaw, Poisson'sratio, modulus of elasticity, modulus of rigidity, stress-strain diagram for ductile and brittle materials, factor of safety and working stress, bulk modulus, inter relation between elastic modulus. Various strengths of material- Yield strength, Ultimate permissible stress. • Axial force diagram, stress-strain, deformations in determinate homogeneous and composite bars of Following types. 1) Prismatic 2) Linearly varying 3) Stepped section under concentrated loads and self-weights. Axial stresses and strain in determinate members –axial homogeneous and composite bars concentrated loads, self-weights and temperature changes. • Conclusion and Summary of Unit
2	**Principle Stresses & Theory of Failure**
	• Introduction of Unit • Principal planes, stresses & strains; Normal and shear stress on any oblique plane, concept of principle plane, derivation of expression for principle stresses and planes and plane of maximum Shear stress, position of principle plane and plane of maximum Shear, graphical solution using Mohr's circle of stresses, combined effect of shear and bending in beams. bending moment & torsional moment on circular shafts. • Theories of Elastic Failures: The necessity for a theory, Strain Energy, different theories- Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory, maximum strain theory – their limitations, significance and comparison &applications. • Conclusion and Summary of Unit
3.	**Shear Force and Bending Moment Diagram**
	• Introduction of Unit • Bending stresses : Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections(rectangular, I,T,C) with respective centroidal & parallel axes, bending stress distribution diagrams, moment of resistance & section modulus calculations. • Shear stresses: Concept, derivation of shear stress distribution formula, maximum and average shears stresses. • Shear Force & Bending Moments: Definitions, SF & BM diagrams for cantilevers, simply supported beams withor without over-hang and calculation of maximum BM & SF and the point of contra-flexure under

	concentrated loads, uniformly distributed loads over whole span or a part of it, combination of concentrated loads and uniformly distributed loads, Problems. • Conclusion and Summary of Unit
4.	**Torsion in Circular Shafts**
	• Introduction of Unit • Torsion of shafts: Introduction, Basic assumptions, Derivation of shear stress produced in a circular shaft subjected to torsion, Max. torque transmitted by a circular and hollow circular shaft. Polar modulus, strength of a shaft and tensional rigidity. • Buckling of columns: Concept of buckling of columns, Stability of equilibrium: Instability & elastic stability. Long & short columns, ideal strut, derivation of Euler's formula for long column, – assumptions and limitations. Euler's formula for crippling load for columns of different ends. Rankine's formula for intermediate columns, safe load on columns, Eccentric loading of columns. • Conclusion and Summary of Unit
5.	**Deflection of Beams and Strain Energy**
	• Introduction of Unit • Transverse deflection of beams: Relation between deflection, bending moment, shear force and load, Transverse deflection of beams and shaft under static loading, area moment method, direct integration method: method of superposition and conjugate beam method. • Elastic strain energy: Strain energy due to axial, bending and Torsional loads; stresses due to suddenly applied loads; use of energy theorems to determine deflections of beams and twist of shafts. • Conclusion and Summary of Unit

C. RECOMMENDED STUDY MATERIAL:

Sr.No	Reference Book	Author	Edition	Publication
1.	Strength of Materials	Khurmi, R.S.	Latest	Khanna Publishers.
2.	Strength of Materials	Ramamurtham, S.	Latest	Dhanpat Rai & Sons
3.	Strength of Materials	Beer F. P. & Johnston S J	Latest	TMH, New Delhi,
4.	Strength of Materials	Bhavikatti S S	Latest	Vikas Publication House , New Delhi,
5.	Strength of material	S.S. Rattan	Latest	TMH
6.	Strength of material	Dr. R. K. Bansal	Latest	Laxmi publication Pvt. Ltd., New Delhi
Important Web Links:				
1.	https://nptel.ac.in/courses/112107146/			
2.	https://nptel.ac.in/courses/112107147/			

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	–	–	–	–	–	–	–	–
CO2	2	3	2	2	–	–	–	–	–	–	–	–
CO3	3	3	2	2	–	–	–	–	–	–	–	–
CO4	3	3	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	2
CO2	–	–	2
CO3	–	–	2
CO4	–	–	3
CO5	–	–	2

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code:	ENGINEERING THERMODYNAMCS	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Explain the basic concept of thermodynamics.

CO2 Analyze the concept of entropy and availability.

CO3 Analyze the properties of steam and vapour processes.

CO4 Apply the concept of gas power cycle and derive the efficiency of Rankine cycle.

CO5 Analyze the design aspects of various types of steam generator and air compressors.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Basic concepts of Thermodynamics	7
2.	Entropy and Availability	7
3.	Properties of Steam and Vapour Processes	8
4.	Steam Cycles And Fuel Combustion	7
5.	Steam Generators and Air compressors	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Basic concepts of Thermodynamics**
	• Introduction of Unit • Basic Concepts: Macroscopic and Microscopic Approaches, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property – Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasi-static, Reversible and Irreversible Processes, Working Substance. Concept of Thermodynamic Work and Heat, Zeroth Law of Thermodynamic and its utility, Problems. • Law of Thermodynamics; First Law of Thermodynamics, Second Law of Thermodynamics: Limitations of First Law, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and their Equivalence, PMMSK. Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot Theorem and its Corollaries. • Conclusion of Unit including real life applications
2.	**Entropy and Availability**
	• Introduction of Unit • Entropy, Clausius Inequality, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics. • Availability and Irreversibility: High and Low Grade Energy, Availability and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Second law efficiencies of processes & cycles. • Conclusion of Unit including real life applications
3.	**Properties of Steam and Vapor Processes**
	• Introduction of Unit • Steam; Pure Substance: Pure Substance and its Properties, Phase and Phase Transformation, Saturated and Superheat Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots During Steam Formation, Properties of Dry, Wet and Superheated Steam, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams. • Ideal Gas Properties and Processes; Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation Avogadro's law and Universal Gas Constant, Ideal gas processes- on P-V and T-S diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic. • Conclusion of Unit including real life applications
4.	**Steam Cycles And Fuel Combustion**

	• Introduction of Unit. • Gas power Cycles:Otto Cycle, Diesel Cycle, Dual Cycle, Stirling Cycle, Ericson cycle and Brayton cycle. Comparison of Carnot cycle and Rankine cycle, Efficiency of Rankine cycle, work ratio, specific steam consumption. Effect of operating variables on Rankine cycle, Reheat and regenerative Rankine. • Types of fuels, Physical law of combustion, composition of dry air, Actual air fuel ratio, excess air, determination of actual quantity of air from combustion analysis, Fuel gas analysis; Orsat apparatus, Enthalpy of formation, Enthalpy of combustion, calorific values and their determination. • Conclusion of Unit including real life applications
5.	**Steam Generators and Air compressors**
	• Introduction of Unit • Steam Generators; Classification, Constructional details of low pressure boilers, Features of high pressure boilers, Construction and working principle of boiler, Boiler mountings and accessories, Boiler efficiency by direct and indirect method Energy balance, Boiler draught • Air Compressor; 1) Reciprocating Air Compressor and 2) Multistage compressors, isothermal efficiency, volumetric efficiency, 3) Rotary Air Compressors: - Classification, Difference between compressors and blowers. • Conclusion of Unit including real life application.

C. RECOMMENDED STUDY MATERIAL:

Sr.No	Reference Book	Author	Edition	Publication
1.	Thermal Engineering	R. K. Rajput	Latest	Laxmi Publication, New Delhi.
2.	Engineering Thermodynamics	P.K. Nag	Latest	Tata McGraw-Hill , New Delhi
3.	Thermal Engineering	S.C. Gupta	Latest	Pearson Education Pvt. Ltd. New Delhi.
4.	Thermal Engineering	P.L. Ballany	Latest	Khanna Publication, New Delhi.
5.	An introduction to Thermodynamics	YVC Rao	Latest	New Age publishers, New Delhi.
6.	Fundamental of Engg. Thermodynamics	R.Yadav	Latest	Central Publishing House, Allahabad
Important Web Links				
1	https://nptel.ac.in/courses/101104063/			
2	https://nptel.ac.in/courses/11210512/			

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	3	2	2	–	–	–	–	–	–	–	–
CO4	3	3	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	3
CO2	–	2	3
CO3	–	2	3
CO4	–	2	3
CO5	–	2	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMEEME3111	MATERIAL SCIENCE AND ENGINEERING	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the features, classification, applications of engineering materials.

CO2 Analyze the structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP,APF (Atomic Packing Factor), Co-ordination Number etc.

CO3 Apply the concept of phase & phase diagram & analyze the basic terminologies associated with metallurgy.

CO4 Apply and suggest the heat treatment process & its types.

CO5 Analyze and suggest the mechanical test.

B. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Classification of Engineering materials	7
2.	Structure of Materials	7
3.	Equilibrium Diagrams	7
4.	Heat Treatments	8
5.	Mechanical Properties and Testing	7

C. DETAILED SYLLABUS

Unit	Unit Details
1.	**Classification of Engineering materials**
	• Introduction of Unit • Engineering materials, classification of engineering materials, metals and alloys, polymers, ceramics, composites. General properties of engineering materials, stress-strain diagram. Selection of engineering materials as per the properties and application areas • Metallic alloys: Ferrous alloys, plain carbon and alloy steels classification, stainless steel, spring steel, tool steels, corrosion resistant steels, high speed steels etc. Cast iron and types. Nonferrous metals and alloys and their applications. • Classification of non-metallic materials: Plastics, ceramics, composites types, their properties, applications and case studies. • Advanced Materials: Materials for modern vehicles, components and their case studies. smart materials, advanced composites and their applications, waste materials and their utilization • Conclusion of Unit including real life applications
2.	**Structure of Materials**
	• Introduction of Unit • Structure of engineering materials. Crystalline structure of solids; development of grain structure, unit cell, atomic and nucleus arrangement. Space lattice, lattice parameters, coordination number, atomic packing factor. • Crystal lattice of simple cubic, body centered cubic, face centered cubic, hexagonal crystal structures. Miller Indices and crystal structure determination methods. • Crystal imperfection: Point defects- vacancy, Schottky's defect, Frankel defect, linear defects or dislocations, surface and volume defects. • Plastic deformation- Role of dislocation, slip, twinning, strain hardening, Bauschinger's effect. Recovery, recrystallization and grain growth • Conclusion of Unit including real life applications
3.	**Equilibrium Diagrams**
	• Introduction of Unit. • Solidification of metals and of some typical alloys: Mechanism of crystallization (i) nuclear formation (ii) crystal growth. General principles of phase transformation in alloys, phase rule, phase diagram and equilibrium diagrams, • Binary isomorphous alloy system, Hume-Rothery rule, Binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with peritectic transformation.

	• Equilibrium diagram of a system whose components are subject to allotropic change. Iron carbon equilibrium diagram, phase transformation in the iron carbon diagram, eutectic, peritectic, eutectoid and peritectoid reactions and microstructures. • Conclusion of Unit including real life applications
4.	**Heat Treatments**
	• Introduction of Unit • TTT curve- Cooling curves superimposed on Isothermal Transformation diagram, critical cooling rate. (i) Formation of Martensite, Bainite • Principles of heat treatment, types and applications. Annealing, normalizing, hardening, tempering types, diagram, objectives and applications. • Chemical Heat treatment of steels: Case hardening, carburising, nitriding, cyaniding, carbonitriding. Flame and Induction hardening • Hardenability and methods for determination of hardenability. Over-heated and burnt steel, temper brittleness -its causes and remedies • Conclusion of Unit including real life application.
5.	**Mechanical Properties and Testing**
	• Introduction of Unit • Mechanical Properties: Static property, tensile test, engineering and true stress, true strain curves, evaluation of properties and significance of test, typical engineering stress-strain diagrams • Destructive Testing; Mechanical Properties and Testing: Types of fracture, testing of materials under tension, compression and shear loads – hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy,fatigue and creep test • Non-destructive testing: Advantages and limitations of destructive and non-destructive testing, liquid penetrant magnetic particle inspection, and ultrasonic test, radiography and eddy current test. • Effect of alloying elements in steels. Steels designation system. • Conclusion of Unit including real life applications

D. RECOMMENDED STUDY MATERIAL:

Sr.No	Reference Book	Author	Edition	Publication
1.	Material science and metallurgy for Engineers	DrV.D.Kodgire	Latest	Vrinda Publications
2.	Material Science.	Narula and Gupta	Latest	New Age Publishers
3.	A Text Book of Material Science & Metallurgy	K. M. Gupta	Latest	Umesh Publications
4.	Material Science and Engineering-An Introduction	Callister W.D.	Latest	John Wiley & Sons. Delhi.
5.	Engineering Materials	Kenneth G. Budinski	Latest	Prentice Hall of India, New Delhi
6.	Material Science & Engineering	V. Raghvan	Latest	Prentice Hall of India, New Delhi
Important Web Links:				
1	https://nptel.ac.in/courses/112108150/			
2	https://nptel.ac.in/courses/113106032/			

E. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	3	2	2	–	–	–	–	–	–	–	–
CO3	2	2	2	2	–	–	–	–	–	–	–	–
CO4	2	2	2	2	–	–	–	–	–	–	–	–
CO5	2	2	2	2	–	–	–	–	–	–	–	–

F. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	—	2	3
CO2	—	2	3
CO3	—	2	3
CO4	—	2	3
CO5	—	—	3

Note: On the basis of mapping of COs with POs, this course is related to Skill Development and Entrepreneurship

Code: BMEEME3112	OPERATION MANAGEMENT	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Understand the scope of operation management and demand forecasting.

CO2 Analyze the various types of production system and capacity planning.

CO3 Apply the production planning objectives and techniques.

CO4 Analyze the concepts of production control system, JIT, pull system etc.

CO5 Apply the concept of material management, requirement, functions.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Basics of Operation Management	7
2.	Production Systems	8
3.	Production Planning	8
4.	Production Control	7
5.	Material Management	8

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Basics of Operation Management**
	• Introduction of Unit • Introduction: Scope of Operations Management, operations manager and the management process. Operations Strategy, Competitiveness and Productivity. • Demand Forecasting: components of forecasting demand, Approaches to forecasting: Qualitative methods, Time series methods, Regression methods, Selection of forecasting technique. • Conclusion of Unit including real life applications
2.	**Production Systems**
	• Introduction of Unit • **Products and Services, Process, Types of Production Systems:** Mass, Batch, Job shop production. Product andprocess matrix. Process planning and Process analysis.**Capacity Planning:** Defining and measuring capacity, steps in capacity planning process, determining capacityrequirements, Capacity alternatives. • Conclusion of Unit including real life applications
3.	**Production Planning**
	• Introduction of Unit • **Production Planning:** Production planning objective and functions, Bill of material, Capacity and man powerrequirement planning, Planning levels: long range, Intermediate range and Short range planning, aggregate planning; Objective, Strategies. • Conclusion of Unit including real life applications
4.	**Production Control**
	• Introduction of Unit • **Production Control:** Capacity control and priority control, production control functions; Routing, scheduling,dispatching, expediting and follow up, batch production and mass production systems, • **Just in Time and Lean Production** Basic element in JIT, Pull system, Push system, Kanban production controlsystem, Benefits of JIT. • Conclusion of Unit including real life applications
5.	**Material Management**
	• Introduction of Unit • **Material Management:** Objectives, scope and functions of material management, planning, procurement, storing,ending and inventory control. Purpose of inventory, inventory cost, inventory control systems, Selective inventory control systems, Determination of EOQ, Lead time and reorder point. • Conclusion of Unit including real life applications

C. RECOMMENDED STUDY MATERIAL

S.No	Book	Author	Edition	Publication
Reference Books				
1.	Operations Management	Krajewski, Ritzman, Kansal	Latest	Pearson
2.	Operations Management	Roberta S. Russell	Latest	Pearson/ PHI
3.	Production and Operations Management	Everette. Adam Jr., Ronald J. Ebert	Latest	PHI
4.	Operations Management	Russell & Taylor III	Latest	Pearson
5.	Operations Management	McGregor D	Latest	McGraw-Hill
6.	Operations Management	Chase, Jacobs, Aquilano, Agarwal		TMH
Important Web Links				
	https://nptel.ac.in/courses/112107238/			
	https://nptel.ac.in/courses/110106046/			
	https://nptel.ac.in/courses/110106045/			

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	–	–	–	–	–	–	–	3	–
CO2	2	2	2	–	–	–	–	–	–	–	3	–
CO3	2	2	2	–	–	–	–	–	–	–	3	–
CO4	3	2	2	–	–	–	–	–	–	–	3	–
CO5	3	2	2	–	–	–	–	–	–	–	3	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	3	–	–
CO2	3	–	–
CO3	3	–	–
CO4	3	–	–
CO5	3	–	–

Note: On the basis of mapping of COs with POs, this course is related to skill development.

Code: BMEEME3113 SMART TECHNOLOGIES FOR INDUSTRY 4.0 3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the drivers and enablers of Industry 4.0.

CO2 Analyze the application of IoT in Smart Factories, Smart cities, smart products and smart services.

CO3 Illustrate the systems used in a manufacturing plant and their role in an Industry 4.0 world.

CO4 Recommend the support system for Industry 4.0 and mobile computing.

CO5 Analyze the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1	Introduction to Industry 4.0	8
2	Road to Industry 4.0	7
3	Related Disciplines, System, Technologies for enabling Industry 4.0	8
4	Role of data, information, knowledge and collaboration in future organizations	8
5	Other Applications and Case Studies	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Industry 4.0**
	• Introduction of Unit • The Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 , The Journey so far: Developments in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation • Conclusion and Summary of Unit
2.	**Road to Industry 4.0**
	• Introduction of Unit • Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Smart Manufacturing , Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics • Conclusion and Summary of Unit
3.	**Related Disciplines, System, Technologies for enabling Industry 4.0**
	• Introduction of Unit • Cyber physical Systems, Robotic Automation and Collaborative Robots , Support System for Industry 4.0 , Mobile Computing, Related Disciplines, Cyber Security • Conclusion of Unit including Real Life Application
4.	**Role of data, information, knowledge and collaboration in future organizations**
	• Introduction of Unit • Resource-based view of a firm, Data as a new resource for organizations, Harnessing and sharing knowledge in organizations, Cloud Computing Basics, Cloud Computing and Industry 4.0 • Conclusion of Unit including Real Life Application
5.	**Other Applications and Case Studies**
	• Introduction of Unit • Industry 4.0 laboratories, IIoT case studies, Case studies from HKPolyU students, opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world • Conclusion of Unit including Real Life Application

C. RECOMMENDED STUDY MATERIAL

S.No.	Reference Book	Author	Edition	Publication
1.	The Fourth Industrial Revolution	Klaus Schwab	Latest	World Economic Forum
2	Industry 4.0: The Industrial Internet of Things	Alasdair Gilchrist	Latest	Press
3.	Industry 4.0 Value Roadmap: Integrating Technology and Market Dynamics for Strategy, Innovation and Operations	Tuğrul U. Daim	Latest	Springer
4	Industry 4.0 and Regional Transformations	Lisa De Propris	Latest	Routledge
Important Web Links:				
1	https://en.wikipedia.org/wiki/Industry_4.0			
2	https://www.dqindia.com/role-digital-verification-signature-scaling-industry-4-0/			

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	–	–	2	–	–	–	2	–	3	–
CO2	2	–	2	–	2	–	–	–	–	–	3	–
CO3	2	2	2	–	2	–	–	–	–	–	3	–
CO4	3	2	2	–	2	–	–	–	–	–	3	–
CO5	3	2	2	–	2	–	–	–	–	–	3	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	3	–	–
CO2	3	–	–
CO3	3	–	–
CO4	3	–	–
CO5	3	–	–

Note: On the basis of mapping of COs with POs, this course is related to skill development employability, and enterneupurship.

Code: BMECME3201	MATERIAL SCIENCE LAB	1 Credits [L T P : 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Identify various microstructures of ferrous metals and alloys

CO2 Identify various microstructures of non-ferrous metals and alloys

CO3 Evaluate harness of treated and untreated steels

CO4 Importance of hardening of steels

CO5 Visualize grains and grain boundaries

1.	Study of Microstructure of pure metals – Iron, copper and aluminum
2.	Study of Microstructure of low carbon steel, mild steel, and high carbon steel
3.	Study of Microstructure of cast iron
4.	Study of Microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and their alloys.
5.	Study of Microstructure of heat treated steels
6.	To determine the hardenability by Jominy end quench test.
7.	Find hardness of various untreated and treated steel
8.	Study of Microstructure of ceramics, polymeric materials
9.	Study of Microstructure of super alloy and nano-materials
10.	Find hardness of ceramics and super alloys, nano-materials and polymeric materials

Virtual Labs

	http://sm-nitk.vlabs.ac.in/#

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	3	2	2	–	–	–	–	–	–	–	–
CO5	2	2	2	2	–	–	–	–	–	–	–	–

CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	2
CO5	–	–	2

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME3202	THERMAL ENGINEERING LAB	1 Credit [LTP : 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Explain the types of boiler, boiler draught and its applications.

CO2 Measure the calorific value of fuel and carry out flue gas analysis.

CO3 Categorize the steam condensers and cooling towers.

CO4 Analyze the basic components of air-conditioning system.

CO5 Analyze the performance of domestic refrigerator.

A. LIST OF EXPERIMENTS

1	To study various types of Boilers (Steam generators) and to study Boiler mounting and accessories
2	Study of boiler draughts.
3	Determination of calorific value using gas calorimeter or Bomb calorimeter.
4	Flue gas analysis using Orsat apparatus or Gas analyzer.
5	Determination of dryness fraction of steam using Throttling Calorimeter or Separating and Throttling Calorimeter.
6	Determination of Isothermal and Volumetric efficiency of reciprocating air compressor.
7	Study of steam condensers and cooling towers.
8	Study of various elements of a mechanical refrigerator system through cut sections models / actual apparatus.
9	To study basic components of air-conditioning system.
10	Experiment on air conditioning test rig and calculation of various performance
11	Study and performance of domestic refrigerator

Virtual Labs	
1	www.khanacademy.com
2	https://realism.io/simulations/bombcalorimeterlab
3	http://web.mst.edu/~gbert/cal/bomb/Acal.html

B. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	2	2	2	2	–	–	–	–	–	–	–	–
CO4	2	2	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

C. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	3
CO2	–	2	3
CO3	–	2	3
CO4	–	2	3
CO5	–	2	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME3203	MATERIAL TESTING LAB	1 Credits [L T P: 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Determine the hardenability, to calculate the effective number of atoms.

CO2 Determine the tensile and compressive properties of material using UTM.

CO3 Differentiate between the Rockwell and Brinell test.

CO4 Conduct the fatigue and creep test and determine the hardness of material.

CO5 Perform the torsion testing and analyze the parameters influencing it.

A. LIST OF EXPERIMENTS

1.	
2.	To determine machine defects by dye-penetrant & magnetic flow detection NDT technique
3.	To calculate the effective number of atoms, co-ordination number, packing factors, Miller indices (plane and Directions)
4.	To prepare metallic samples for metallographic examination and to study the principle and construction of the Metallurgical Microscope
5.	To determine flows by ultrasonic technique.
6.	To determine tensile and compressive properties of ductile and Non Ductile material with the help of Universal testing machine (UTM).
7.	To determine the impact strength of materials with the help of Charpy- Izod Impact Test
8.	To determine hardness of material with the help of Rockwell Hardness tester
9.	To determine hardness of material with the help of Brinell Hardness tester
10.	Fatigue testing on fatigue testing machine.
11.	Creep testing on creep testing machine.
12.	Torsion testing of a rod on torsion testing machine.
13.	Deflection of beam experiment, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam

Virtual Labs

	http://sm-nitk.vlabs.ac.in/#

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	3	2	2	–	–	–	–	–	–	–	–
CO5	2	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	2
CO5	–	–	2

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME3205	MACHINE DRAWING AND AUTO CAD LAB	1 Credit [LTP: 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Illustrate various machine components through drawings.

CO2 Differentiate between part and detailed drawing.

CO3 Analyze the various parts of Lathe Tailstock, Connecting Rod and C Clamp.

CO4 Apply the basic commands of AutoCAD.

CO5 Create 2D and 3D model in AutoCAD.

A. LIST OF EXPERIMENTS:

1	Assembly Drawings – C Clamp
2	Assembly Drawings – IC Engine- Connecting Rod
3	Assembly Drawings- Lathe Tailstock
4	Orthographic Views : Drawing Tools: Arc, Ellipse, Polygon, Rectangle, Multiline, Pline, Xline, Modify Tools: Erase, oops, Undo, Redo, Explode,
5	Drawing Tools: Move, Copy, Rotate, Mirror, Array, Scale, Trim, Extend, Chamfer, Fillet, Mline, Mlstyle
6	Display Control: Zoom, Pan, Redraw, Regen, Object Properties: Color, Linetype, Ltscale, Lineweight, Properties, Matchprop
7	Dimension - Linear, Aligned, Radius, Diameter, Center Mark, Angle, Arc length, Continues, Baseline, Dimension Style, Leader, Qleader
8	Layer Management- Adding / Removing Layers, Layer Status, New Property Filter, New Group Filter, Layer Status Manager, Plot Control
9	Block Creation, Insert, Attribute
10	Introduction to plotting, Layout, Mview, Page setup, Plot
Virtual Labs	
1	http://www.vlab.co.in/participating-institute-iit-kharagpur
2	https://www.autodesk.com

B. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	–	–	–	–	–	–	–	–
CO2	3	3	2	2	–	–	–	–	–	–	–	–
CO3	3	3	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	2	3	2	2	–	–	–	–	–	–	–	–

C. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	3	2
CO2	–	2	3
CO3	–	3	3
CO4	–	2	2
CO5	–	2	3

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill development

Code: Principle of Human Recourse Management 2 Credits [LTP: 2-0-0]

Course Objectives:

1. To introduce the basic concepts of Human Resource Management.
2. To cultivate right approach towards Human Resource and their role in business.
3. To create awareness about the various trends in HRM among the students.

Unit No.	Title of the unit	Time Required for the Unit (Hours)
1.	**Introduction to HRM**	
2.	**Human Resources Planning**	
3.	**Performance Appraisal**	
4.	**Introduction to Organizational Behavior**	
5.	**Organizational Changes and Development**	

CO	Cognitive Abilities	Course Outcomes
CO1	Analyzing	ANALYZE the basic need and concept of HRM
CO2	EVALUATION	Evaluating the Objectives-Importance-HRP Process
CO3	Analyzing	Evaluate the Methods of Training –Tools and Aids
CO4	Analyzing	Analyze the Concepts and Ethics-Different methods of Performance Appraisal
CO5	Evaluating	Evaluate about Concepts and Components-Job Evaluation- Incentives and Benefits-Superannuation.

Unit	Unit Details
1.	**Introduction to HRM**
	Introduction and Importance-Evolution –difference between Personnel Management and HRM- Strategic HRM- role of a HR Manager. HRD – Concept and Need
2.	**Human Resources Planning**
	Objectives-Importance-HRP Process- Manpower Estimation-Job analysis-Job Description-Job Specification. Recruitment-Sources of Recruitment-Selection Process-Placement and Induction-Retention of Employees.

3.	**Training and Development and Career Planning**
	Objectives and Needs-Training Process-Methods of Training –Tools and Aids-Evaluation of Training Programs. Succession Planning.
4.	**Performance Management System**
	Definition, Concepts and Ethics-Different methods of Performance Appraisal- Rating Errors-Competency management, Potential Appraisal
5.	**Compensation Management and Retirement**
	Concepts and Components-Job Evaluation- Incentives and Benefits-Superannuation-Voluntary Retirement Schemes-Resignation-Discharge-Dismissal-Suspension-Layoff.

Sr. No.	**Title of the Book**	**Author/s**	**Publication**	**Place**
1	Human Resource Management	L. M. Prasad	Sultan Chand & Company Ltd.	New Delhi
2	Human Resource Management	K. Ashwathappa	Tata McGraw Hill	New Delhi
3	Personnel Management	C. B. Mamoria	Himalaya Publishing House	Mumbai
4	Personnel & Human Resource Management	A. M. Sharma	Himalaya Publishing House	Mumbai
5	Human Resource Management	S. S. Khanka	Sultan Chand & Company Ltd.	New Delhi

Code:BMECME3204	TECHNICAL SEMINAR	1 Credit [LTP: 0-0-2]

COURSE OVERVIEW AND OBJECTIVES:

- To practice various activities involved in a seminar talk – gathering information, preparation of slides, discussion, reporting.
- To develop the communicative and writing skills in technical reporting.

1. **For seminar every student will individually study a topic assigned to him / her and submit a report and shall deliver a short lecture / Seminar on the topic at the end of term.**
2. **Selection of topic should be done by students in consultation with concerned guide**

   a). Topic should be related to branch but it should be extended part of the branch (latest and advance topic).

   b). The topic should be such that the student can gain latest knowledge. Student should preferably refer at least one research paper
3. **Seminar topic should not be repeated in the department and registration of the same should be done on first come first served basis.**
4. **Seminar report should be submitted in paper bound copy prepared with computer typing**

   a). Size of report depends on advancement of topic.

   b). Student should preferably refer minimum 5 reference books / magazines.

   c). Format of content: i. Introduction. ii. Literature survey. iii. Theory 1) Implementation 2) Methodology 3) Application 4) Advantages, Disadvantages. iv. Future scope. v. Conclusion

CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
C411.1	3	2	2	2	–	–	–	–	–	–	–	–
C411.2	3	2	1	1	–	–	–	–	–	–	–	–
C411.3	3	2	2	2	–	–	–	–	–	–	–	–
C411.4	3	1	1	1	–	–	–	–	–	–	–	–
C411.5	3	2	2	2	–	–	–	–	–	–	–	–

CO-PSO Mapping

	PSO 1	PSO 2	PO 3
C411.1	–	**2**	–
C411.2	–	**2**	–
C411.3	–	**2**	–
C411.4	–	**2**	–
C411.5	–	**2**	–

Note: On the basis of mapping of COs with POs, this course is related to Employability.

FOURTH SEMESTER

Code: BMECME4101	THEORY OF MACHINES	4 Credits [LTP: 3-1-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the various kinematics links and mechanisms.

CO2 Identify the governing and gyroscopic couple effect on vehicle.
CO3 Explain the gear, gear trains and their applications.
CO4 Examine modelling of vibrating systems in undamped free vibration of single degree freedom systems.
CO5 Illustrate the concept of critical damping and its importance in damped free vibration of single degree freedom system

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Fundamentals of Kinematics	9
2.	Friction devices and clutches	9
3.	Gears	10
5.	Undamped free vibration	10
5.	Damped free vibration	10

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Fundamentals of Kinematics**
	• Introduction of Unit • Introduction to mechanism: Basic concept of machines, link, kinematic pairs, kinematic chain, and mechanism. Inversions of kinematic chains: four bar chain mechanism, quick return mechanisms, inversions of double slider crank mechanisms. Velocity and acceleration in mechanism: velocity and acceleration polygons, relative velocity and instantaneous centre method. Cams: Types of cams- displacement, velocity and acceleration curves for different camfollowers, consideration of pressure angle and wear. • Conclusion and Summary of Unit.
2.	**Mechanisms for Control**
	• Introduction of Unit • Governor: a) Types of governors – Watts, Porter, Proell, Hartnell governor, and spring controlled governors b) Sensitiveness of governors, c) Hunting, Isochronisms, stability, d) Effect of governor, e) Power of governor, controlling force. • **Gyroscope:** Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicle taking a turn, stabilization of sea vessels. • Conclusion of Unit including Real Life application.
3.	**Gears**
	• Introduction of Unit • Gear: a) **Spur Gears: -** Law of gearing & Terminology used in gears, conjugate action, in volute and cycloidal profile, path of contact, arc of contact, contact ratio, interference, undercutting, methods to avoid undercutting and interface, gear standardization, effect of center distance variation on the velocity ratio for involute profile tooth gears. **Gear Trains:** - Simple, compound and epicyclic gear trains. Analytical and graphical method for velocity ratio. Conclusion of Unit including Real Life application
4.	**Undamped free vibration of single degree freedom systems**
	• Introduction of Unit • **Undamped free vibration of single degree freedom systems:** Modelling of Vibrating Systems, Evaluation of natural frequency – differential equation, Energy & Rayleigh's methods, Equivalent systems. Conclusion of Unit including Real Life Application
5.	**Damped free vibration of single degree freedom systems**
	• Introduction of Unit • **Damped free vibration of single degree freedom systems:** Different types of damping, Concept of critical damping and its importance, study of vibration response of viscous damped systems for cases of underdamping, critical damping

C. RECOMMENDED STUDY MATERIAL:

Sr.No	Reference Book	Author	Edition	Publication
1.	Theory of Machine"	Khurmi, R.S., Gupta, J.K.	Latest	S. Chand.
2.	Theory of Machines and Mechanisms	Shigley J.E. and Uicker J.J.	Latest	McGraw Hill, Inc.
3.	Theory of Machines	Rattan S. S.	Latest	Tata McGraw Hill.
4.	Theory of Machines	Ballaney P. L.	Latest	Khanna Publishers, Delhi.
5.	Mechanism and Machine Theory	Rao, J.S., and Dukkipati, R.V.	Latest	Wiley Eastern Ltd.
6.	Kinematics and Linkages Design	Hall A.S.	Latest	Prentice-Hall.
Important Web Links				
1	https://nptel.ac.in/courses/11210412/			
2	https://nptel.ac.in/courses/11210411/			

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	–	–	–	–	–	–	–	–
CO2	2	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	2	2	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	3
CO2	–	2	3
CO3	–	2	3
CO4	–	2	3
CO5	–	2	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME4102	MECHATRONICS	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Explain the term mechatronics and its various components.

CO2 Analyze the role of signal conditioning in electronics domain and data presentation system.

CO3 Categorize the different types of actuators used in mechatronics system.

CO4 Analyze the working of microprocessors and microcontrollers and various types of control system and controllers.

CO5 Examine the influence of industrial design, aesthetics and ergonomics on product design, man –machine interface and conveyor based material handling systems.

B. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Basics of Mechatronics	7
2.	Data acquisition system	7
3.	Actuators and Mechanisms	7
4.	Microprocessors and Microcontrollers	8
5.	Industrial Design, Aesthetics and Ergonomics	7

C. DETAILED SYLLABUS

Unit	Unit Details
1.	**Basics of Mechatronics**
	• **Introduction to Mechatronics** Scope and importance of mechatronics, Key issue, Systems, Measurement systems. • Transducers and Sensors Introduction, Difference between transducer and sensor, Transducer types,Transduction principle, Photoelectric transducers – photoemissive transducers, photoconductive transducers, photovoltaic transducers, Thermistors, Thermodevices, Thermocouple, Inductive transducers, Capacitive transducers. • Conclusion of Unit including real life applications
2.	**Data acquisition system**
	• Introduction of Unit • **Signal Conditioning**: Introduction, Voltage divider, Rectification, Diode voltage stabilizer, Clipping and Clamping circuit, more about filter circuits, Isolator, Instrumentation amplifier, Bridge circuit, Comparator, Oscillator, Sample and Hold, Clock, Analog to Digital conversion principle, successive approximation method. • **Data Presentation and Data Logging Systems:** Introduction, Recorders–Graphic recorders, Strip chart recorders, X-Y recorders, Magnetic tape recorder. Data loggers – block diagram description, Data acquisition system – generalized data acquisition system, computer based data acquisition system. • Conclusion of Unit including real life applications
3.	**Actuators and Mechanisms**
	• Introduction of Unit • Actuators and Mechanisms: Introduction, Actuator types and application areas, Electromechanical actuators, DC Motors – brushed DC motor, brushless, coreless, AC Motors – induction motors, synchronous motors, stepper motor, Fluid power actuators – pneumatic actuators, valves actuators, hydraulic actuators, comparison, Piezoelectric actuators– an illustration, piezoelectric motor, Magnetostrictive actuators, Memory metal actuators. • Conclusion of Unit including real life applications
4.	**Microprocessors and Microcontrollers**
	• **Introduction to Microprocessors and Microcontrollers** Microprocessor–Introduction, Basic element of control systems Microcontrollers – Introduction, Difference between Microprocessors and Microcontrollers Programmable logic controllers – Introduction.

	• **Control Systems and Controllers** Introduction, Control system, Open-loop control systems, Closed-loop control systems – notations, reachability, transfer function. The Controllers – on-off controller, proportional controller, integral controller, derivative controller, proportional plus integral controller. • Conclusion of Unit including real life applications
5.	**Industrial Design, Aesthetics and Ergonomics**
	• Introduction of Unit • Integration: Man machine interface, Drilling machine, Conveyor based material handling systems – validation, design. • Industrial Design, Aesthetics and Ergonomics: Introduction, Element of product design–product physiognomy aesthetics, product physiogonomy ergonomics, ergonomics in machine tool design, ergonomics in machine tool safety, product safety audit, Ergonomic factors for advanced manufacturing systems – machine oriented industrial design, factory without people, ergonomic problems in new technology. • Conclusion of Unit including real life applications

D. RECOMMENDED STUDY MATERIAL

S .No	Book	Author	Edition	Publication
Reference Books				
1.	Mechatronics	J.G. Joshi	Latest	Prentice Hall of India
2.	Mechatronics	HMT Limited	Latest	Tata McGraw-Hill
3.	Mechatronics	R.P. Borole	Latest	Nirali Prakashan, Jalgaon
4.	Mechatronics	N.P. Mahalik	Latest	Tata McGraw-Hill
5.	Mechatronics	W. Bolton	Latest	Pearson Education
6.	Applied Mechatronics	A. Smaili	Latest	Oxford University Press
7.	Introduction to Mechatronics	D.R. Appukuttan	Latest	Oxford University Press
Important Web Links				
	https://nptel.ac.in/courses/112103174/			
	https://nptel.ac.in/content/syllabus_pdf/112103174.pdf			

E. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	2	–	–	–	–	–	–	–	–
CO2	2	3	2	2	–	–	–	–	–	–	–	–
CO3	2	3	2	2	–	–	–	–	–	–	–	–
CO4	2	3	2	2	–	–	–	–	–	–	–	–
CO5	2	3	2	2	–	–	–	–	–	–	–	–

F. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME4103	MANUFACTURING PROCESSES	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the different casting processes and complexity involved in producing a casting.

CO2 Analyze and access the importance of welding processes in manufacturing and select the appropriate welding process based on the type of industrial application.

CO3 Analyze the various forming and shaping processes.

CO4 Analyze the powder metallurgy processes and principle and types of rapid prototyping techniques.

CO5 Analyze the functioning of various plastic technologies.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Foundry Technology	9
2.	Metal Joining Processes	8
3.	Forming and Shaping Processes:	8
4.	Powder Metallurgy	7
5.	Plastic Technology	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Foundry Technology**
	• Introduction of Unit • Importance of manufacturing, Technological definition of manufacturing, Types of production & production processes. • Foundry Technology: Patterns practices: Types of patterns, allowances and material used for patterns, moulding materials, moulding sands, Moulding sands; properties, grain fineness; moisture content, permeability test. • Moulding practices**:** Green, dry and loam sand moulding, pit and floor moulding; shell moulding. • Casting practices: Fundamental of metal casting, sand casting, Shell-Mould casting, investment casting, Permanent mould casting, die casting, centrifugal casting, continuous casting, casting defects, gating system design, and riser design. • Conclusion of Unit including real life applications
2.	**Metal Joining Processes**
	• Introduction of Unit • Metal Joining Processes: Principle of welding, Arc welding, Gas welding and cutting: Processes and equipments. • Resistance welding: principle and equipments; Spot, projection and seam welding process. Ultrasonic and laser beam welding, electron beam welding and special welding processes; TIG, MIG, friction and explosive welding, welding defects. • Conclusion of Unit including real life applications
3.	**Forming and Shaping Processes**
	• Introduction of Unit • Metal working, elastic and plastic deformation, concept of strain hardening, hot and cold working, rolling, principle and operations, • Forging: forging operations, wire and tube drawing processes. Method of forging. Cold working processes- Shearing, drawing, squeezing, blanking, piercing, deep drawing, coining and embossing. • Sheet Metal working: Presses and their classification, Die & punch and press work methods and processes. Blanking and Piercing. • Conclusion of Unit including real life applications
4.	**Powder Metallurgy**

	• Introduction of Unit. • Powder manufacturing, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, properties of metal powders, advantages and applications of Powder manufacturing. • Rapid Prototyping Operations: Introduction, subtractive processes, additive processes. • Conclusion of Unit including real life applications
5.	**Plastic Technology**
	• Introduction of Unit • Plastic Technology: Review of plastics, and its past, present & future uses, Classification of Plastics, Ingredients of Moulding compounds, General Properties of Plastics, Manufacturing of Plastic components: Injection moulding, compression moulding, transfer moulding. Resins & Adhesives. • Conclusion of Unit including real life application.

C. RECOMMENDED STUDY MATERIAL:

Sr.No	Reference Book	Author	Edition	Publication
1.	Production Technology Volume I & II	P.N. Rao	Latest	Tata McGraw Hill Publication.
2.	Production Technology	R.K. Jain	Latest	Khanna Publishers.
3.	Elements of Workshop Technology Volume I&II	HajaraChoudhari, Bose S.K.	Latest	Asia Publishing House
5.	Materials and Process Manufacturing	E. Paul De. Garmo,	Ninth	John Willey Publication
6.	Production Technology	P.C. Sharma	Latest	Khanna Publishers.
Important Web Links				
1	https://nptel.ac.in/courses/112107219/			
2	https://nptel.ac.in/courses/112107145/			

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	3	2	2	–	–	–	–	–	–	–	–
CO3	3	3	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	2	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	3
CO2	–	2	3
CO3	–	2	3
CO4	–	2	3
CO5	–	2	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME4104 FLUID MECHANICS AND FLUID MACHINES 3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the basic principles of fluid mechanics and develop ability to analyze fluid flow problems with the application of the momentum and energy equations.

CO2. Apply the conservation laws in differential forms and apply them to determine velocities, pressures and acceleration in a moving fluid.

CO3 Analyze the losses in pipes and evaluate the flow through pipes.

CO4 Illustrate the design aspects of various types of hydraulic turbines.

CO5 Examine the construction of centrifugal pumps and determine its efficiency.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1	Fluid Statics	06
2	Fluid kinematics & Fluid dynamics	08
3	Closed conduit flow	07
4	Hydraulic Turbines	08
5	Centrifugal pumps	07

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Fluid Statics**
	• Introduction of Unit • Dimensions and units: physical properties of fluids- specific gravity, viscosity surface tension- vapor pressure and their influence on fluid motion- atmospheric gauge and vacuum pressure –measurement of pressure- Piezometer, U-tube and differential manometers. • Conclusion and Summary of Unit
2.	**Fluid kinematics & Fluid dynamics**
	• Introduction of Unit • Fluid kinematics: stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational, and irrotational flows-equation of continuity for one dimensional flow.Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend. • Conclusion and Summary of Unit
3.	**Closed conduit flow**
	• Introduction of Unit • Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow: pilot tube, venturimeter, and orifice meter, Flow nozzle, Turbine flow meter • Conclusion of Unit including Real Life Application
4.	**Hydraulic Turbines**
	• Introduction of Unit • classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine- working proportions, work done, efficiencies, hydraulic design –draft tube- theory- functions and efficiency. • Conclusion of Unit including Real Life Application
5.	**Centrifugal pumps**
	• Introduction of Unit • Classification, working, work done – manometric head- losses and efficiencies- specific speed- pumps in series and parallel-performance characteristic curves, NPSH. Reciprocating pumps: Working, Discharge, slip, indicator diagrams • Conclusion of Unit including Real Life Application

C. RECOMMENDED STUDY MATERIAL:

Sr.No	Reference Book	Author	Edition	Publication
1.	Text book of Fluid Mechanics & Hydraulic Machines	R.K. Bansal	Latest	R.K. Bansal
2.	Hydraulic and Fluid Mechanics	Dr. P.N Modi ,Dr. S.M Seth	Latest	Standard Book House.
3	Fluid Mechanics and Machinery	D. Rama Durgaiah		New Age International.
4	Hydraulic Machines	Banga& Sharma	Latest	Khanna Publishers
Important Web Links:				
1	https://nptel.ac.in/courses/112105206/			
2	en.wikipedia.org/wiki/Fluid Mechanics and Machinery			

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	2	2	2	2	–	–	–	–	–	–	–	–
CO5	3	3	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMEEME4111 NON DESTRUCTIVE EVALUATION AND TESTING 3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student will be able to:

CO1 Describe the importance of non-destructive testing methods for evaluation of products/materials.

CO2 Apply the basic testing knowledge of liquid penetrant testing methods for product testing.

CO3 Illustrate the flaw detection using magnetic particle inspection and eddy current methods.

CO4 Analyze the various defects occurred in the products during manufacturing through ultrasonic testing.

CO5 Select the appropriate technique and exposure time for a better imaging in radiography testing.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	**Introduction to Non Destructive Evaluation and Testing**	6
2.	**Optical Methods and Liquid Penetrant Testing**	6
3.	**Electro-Magnetic Testing**	7
4.	**Ultrasonic Testing**	8
5.	**Radiographic Testing**	9

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Non Destructive Evaluation and Testing**
	• Introduction of Unit • NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization, Relative merits and limitations. • Conclusion of Unit including Real Life Application
2.	**Optical Methods and Liquid Penetrant Testing**
	• Introduction of Unit • Optical Methods: holography- Principles and practices of Optical holography, x-ray and electron beam holography techniques • Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. • Conclusion of Unit including Real Life Application
3.	**Electro-Magnetic Testing**
	• Introduction of Unit • Magnetic Particle Inspection – Principle, procedure, Interpretation and evaluation of test indications, Principles and methods of demagnetization • Eddy Current Testing- Introduction to electrical impedance, principles of eddy current testing, flaw detection using eddy currents • Conclusion of Unit including Real Life Application
4.	**Ultrasonic Testing**
	• Introduction of Unit • Ultrasonic Testing- Generation of ultrasonic waves, Horizontal and shear waves, Near field and far field acoustic wave description, Ultrasonic probes- Straight beam, direct contact type, Angle beam, Transmission/reflection type, and delay line transducers, acoustic coupling and media, Transmission and pulse echo methods, A-scan, B-scan, C-scan, F- scan and P-scan modes, Flaw sizing in ultrasonic inspection. • Conclusion of Unit including Real Life Application
5.	**Radiographic Testing**

	• Introduction of Unit • Radiographic Methods- Introduction to x-ray radiography, the radiographic process, X-ray and Gamma ray sources, Geometric principles, Factors governing exposure, radio graphic screens, scattered radiation, arithmetic of exposure, radiographic image quality and detail visibility, industrial X-ray films. • X-Ray Radiography Processes- Fundamentals of processing techniques, process control, the processing room, special processing techniques, paper radiography, and film graininess signal to noise ratio in radiographs. • Conclusion of Unit including Real Life Application

C. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
1	NDT & Evaluation of Materials	J. Prasad & C G K Nair	Latest	Tata McGraw Hill
2	Non Destructive Testing of Materials	V. Jayakumar & K. Elangovan	Latest	Laxmi Publication
3	Radiography in Modern Industry	W. R. Garrett, H. R. Splettstosser, D. E. Titus	1980	Eastman Kodak Company
4	Introduction to the Non-Destructive Testing of Welded Joints	R Halmshaw	1960	Woodhead Publishing Ltd.
Important Web links				
1	https://nptel.ac.in/courses/113106070			
2	https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx			

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	2	2	2	2	–	–	–	–	–	–	–	–
CO5	3	3	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMEEME4112	AUTOMATION AND ROBOTICS	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Identify the potential areas for automation and justify the need for automation.

CO2 Analyze the automated production lines, transfer lines and inspection methods.

CO3 Explain the law of robotics and classification of robots.

CO4 Classify the various types of sensors and end effectors used in robots

CO5 Apply the control of robots for some specific applications.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to automation	7
2.	Automated production Lines	8
3.	Robotics	7
4.	Robot sensor and end efforts	7
5.	Robot Control and Applications	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Automation**
	• Introduction of Unit • Basic elements of an automated system, advanced automation functions, levels of automation, process industries versus discrete manufacturing industries, FMS. Hardware components for automation and process control, sensors, actuators. Social issues of automation, types of automation, reasons of automation. • Basic elements of fluid power system, advantages and disadvantages of fluid power, application of fluid power. Pneumatic vs. hydraulics, Advantages and disadvantages of pneumatics and hydraulics. • Conclusion and Summary of Unit
2.	**Automated production Lines**
	• Introduction of Unit • Fundamentals of automated production lines, application of automated production lines, analysis of transfer lines, types of assembly lines, reasons for using automated assembly lines, fundamentals of automated assembly systems, barcode technology, RFID etc. • Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, other optical Inspection Methods. • Conclusion of Unit including real life applications
3.	**Robotics**
	• Introduction of Unit. • History of robots. Definition of robots. Industrial robots, law of robotics. Advantages and disadvantages of robots. Characteristics of an industrial robot, components of an industrial robot. Classification of robots- Robot classification on the basis of co-ordinate system, basics of power supply, basis of method of control, basis of programming method. Robotic safety, maintenance. • Conclusion of Unit including real life applications
4.	**Robot sensor and end efforts**
	• Introduction of Unit. • Types of sensors in robots. Tactile sensor, Proximity sensor (Position sensor), Range sensor, Machine vision sensor, Velocity sensor. • Robot end effectors- End effectors, classification of end effector, gripper, selection of gripper, Types of grippes, Finger gripper, Mechanical grippers. • Conclusion of Unit including real life applications
5.	**Robot Control and Application**

	• Introduction of Unit • Basics of control: open loop- closed loop, Transfer functions. Types and components of a robot, Embedded systems: Microcontroller Architecture, Kinematic Modeling: Translation and Rotation Representation, Coordinate transformation. • Robot capabilities, application of robots, manufacturing applications, material handling applications. • Conclusion of Unit including real life application.

C. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
1.	Robotics and Control	Nagrath and Mittal	Latest	Tata McGraw-Hill
2.	Robot Dynamics and Control	Spong and Vidhyasagar	Latest	John Wiley and sons
3.	Introduction to Robotics – Analysis, Systems and Application	Saeed B. Niku	Latest	PHI
4.	Robotics for Engineers	YoramKoren	Latest	McGraw Hill International
5.	Robotic Engineering – An Integrated Approach	Klafter, Chmielewski and Negin	Latest	PHI
Important Web links:				
1	https://nptel.ac.in/courses/112101098/			
2	https://nptel.ac.in/courses/112105249/			

CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	–	2	2	–	–	–	–	–	–	–
CO2	3	–	2	2	2	–	–	–	–	–	–	–
CO3	3	2	2	–	2	–	–	–	–	–	–	–
CO4	3	2	–	2	2	–	–	–	–	–	–	–
CO5	2	3	2	–	2	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 1	PO 3
CO1	–	2	–
CO2	–	2	–
CO3	–	2	–
CO4	–	2	–
CO5	–	2	–

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill development

Code: BMEEME4113	BIG DATA ANALYTICS FOR MANUFACTURING	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student will be able to:

CO1 Analyze the business decisions and create competitive advantage with Big Data analytics

CO2 Illustrate the basic concepts of Data Warehousing and its components.

CO3 Apply the techniques of Data Warehousing and Online analytical processing model.

CO4 Recommend the fundamental processes, concepts and techniques of data mining and develop an appreciation for the inherent complexity of the data- mining task

CO5 Apply Hadoop tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	**Introduction To Big Data**	6
2.	**Overview and concepts Data Warehousing**	7
3.	**Concepts and techniques in Data Warehousing**	7
4.	**Mining data streams**	7
5.	**Hadoop Implementation and Deployment**	9

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction To Big Data**
	• Introduction of Unit • Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools. • Conclusion of Unit including Real Life Application
2.	**Overview and concepts Data Warehousing**
	• Introduction of Unit • Overview and concepts Data Warehousing What is data warehousing - The building Blocks, Defining Features – Data warehouses and data marts, Overview of the components, Metadata in the data warehouse, Need for data warehousing, Basic elements of data warehousing, Trends in data warehousing • Conclusion of Unit
3.	**Concepts and techniques in Data Warehousing**
	• Introduction of Unit • OLAP (Online analytical processing) definitions, Difference between OLAP and OLTP, Dimensional analysis - What are cubes?, Drill-down and roll-up - slice and dice or rotation, OLAP models, ROLAP versus MOLAP, defining schemas: Stars, snowflakes and fact constellations • Conclusion of Unit
4.	**Mining data streams**
	• Introduction of Unit • Mining data streams : Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis- Stock Market Predictions. , • Conclusion of Unit
5.	**Hadoop Implementation and Deployment**
	• Introduction of Unit • Hadoop Implementation and Deployment: Introducing Hadoop, Hadoop cluster components, Hadoop Architecture,

	Hadoop Ecosystem, Evaluation criteria for distributed MapReduce runtimes, Enterprise-grade Hadoop Deployment, Hadoop Implementation. • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL

Sr. No.	Reference Book	Author	Edition	Publication
1	The Data Revolution: Big Data, Open Data, Data Infrastructures, And Their Consequences	Rob Kitchin	Latest	SAGE Publications Ltd
2	Big Data in Practice	Bernard Marr	Latest	Wiley
3	Big Data Demystified	David Stephenson	Latest	Pearson Education
4	Big Data and Analytics	Subhashini Chellappan Seema Acharya	2nd Edition	Wiley
Important Web links				
1	https://nptel.ac.in/courses/106104189/			
2	https://www.tutorialspoint.com/big_data_analytics/index.htm			

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	–	3	2	2	–	–	–	–	2	–	–	–
CO2	–	3	2	2	–	–	–	–	2	–	–	–
CO3	–	2	3	2	–	–	–	–	2	–	–	–
CO4	–	3	2	2	–	–	–	–	2	–	–	–
CO5	–	2	3	2	–	–	–	–	2	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	2	–	–
CO2	2	–	–
CO3	2	–	–
CO4	2	–	–
CO5	2	–	–

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill development

Code: BMECME4201	THEORY OF MACHINE LAB	1 Credit [LTP: 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the different types of kinematic mechanism like four bar etc.

CO2 Apply the concept of slip and measure the slip of the belt drive.

CO3 Create the characteristic curves of governors and gyroscopic principle.

CO4 Analyze gear box types and epicyclic gear train torque transmitted and holding torque.

CO5 Analyze and perform the static and dynamic balancing of a rotor.

A. LIST OF EXPERIMENTS

1.	To study inversion of four bar chain Mechanism.
2.	Study of quick return mechanism. (Crank and Slotted lever mech.)
3.	To draw velocity and acceleration diagram for Crank and slotted lever mechanism.
4.	Study of inversion of Double slider chain Mechanism.
5.	To determine moment of inertia of the given object using of Trifler suspension.
6.	Study of various cam-follower arrangement.
7.	To Perform characteristics of a Watt/ Porter governor.
8.	Performance characteristics of a spring-loaded governor.
9.	Performance characteristics of a proell governor.
10.	Study and perform the gyroscopic effect principle
11.	Study of various types of gearboxes such as industrial gearboxes, Synchromesh gearbox, Differential gearbox.
12.	To study and perform epi-cyclic gear train and to measure torque transmitted and holding torque.
13.	To study and perform the dynamic balancing machine and to balance a rotor.

Virtual Labs	
□	http://mm-nitk.vlabs.ac.in/exp1/index.html#
□	http://mm-nitk.vlabs.ac.in/exp7/index.html
□	http://mm-nitk.vlabs.ac.in/exp9/index.html
□	http://mm-nitk.vlabs.ac.in/exp29/index.html
□	http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/dynamics-of-machine-lab/labs/proell-governor-nitk/simulation.html
□	http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/dynamics-of-machine-lab/labs/porter-governer-nitk/index.html

B. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	2	–	–	–	–	–	–	–	–
CO2	2	3	2	2	–	–	–	–	–	–	–	–
CO3	2	3	2	2	–	–	–	–	–	–	–	–
CO4	2	3	2	2	–	–	–	–	–	–	–	–
CO5	3	3	2	2	–	–	–	–	–	–	–	–

C. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill development

Code:BMECME4202	MANUFACTURING TECHNOLOGY LAB – I	1 Credit [L T P : 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Apply the concept of joining processes and perform welding operation.

CO2 Create a pattern and mould for casting.

CO3 Analyze the mechanism of the shaper machine and tube bending techniques.

CO4 Apply the concept of machining processes and perform the operations on lathe like turning, knurling etc.

CO5 Apply the concept of sheet metal working and perform the blanking and piercing operation.

A. LIST OF EXPERIMENTS

1	Welding Shop- One job on welding (fabrication) preparing a component comprising welding joints such as shoe rack, book rack, stands for flower pots, house hold applications etc.
2	Machine Shop- One composite job involving different machine operation on Lathe, Shaper, Slotter, Drilling, Milling & Grinding operations.
3	Making a simple solid pattern involving wood turning – one job
4	Forging - power hammer study & operation
5	To study shaper machine, its mechanism and calculate quick return ratio.
6	To prepare mould of a given pattern requiring core and to cast it in aluminum.
7	To find clay content and moisture content from mould sand
8	To study Tube bending on tube bending m/c.
9	Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).
10	To perform step turning, knurling and chamfering on lathe machine as per drawing.
11	Press work experiment such as blanking/piercing, washer, making etc.

Virtual Labs	
	http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/machine_tools/labs/exp1/simulation.php
	https://fab-coep.vlabs.ac.in/exp1/Simulator.html?domain=Mechanical%20Engineering&lab=FAB%20laboratory
	https://virtlabs.tech/metal-cutting/
	https://fabcoep.vlabs.ac.in/exp7/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20FAB%20laboratory!

B. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	2	3	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

C. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	2
CO2	–	–	2
CO3	–	–	2
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME4203	FLUID MECHANICS AND FLUID MACHINES LAB	1 Credit [L T P: 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the viscosity of liquid and metacentric height of a given object

CO2 Analyze the head loss in length of pipe and also flow rate by venture and orifice meter

CO3 Illustrate the laminar and turbulent flow by use of Reynolds apparatus and determine flow rate by nozzle meter

CO4 Illustrate the momentum equation and also determine coefficient of friction in pipe

CO5 Recommend the performance characteristic curves of hydraulic turbines.

A. LIST OF EXPERIMENTS

1	Determination of viscosity of liquids and its variation with temperature.
2	Determine Metacentric height of a given body
3	Determine head loss of given length of pipe.
4	Determine flow rate of air by Venturi meter and orifice meter
5	Study of Laminar and Turbulent flow by use of Reynolds apparatus
6	Determine flow rate of air by nozzle meter.
7	Study of momentum equation
8	Determination of co-efficient of friction in pipes
9	Determine Cd, Cv& Cc for given orifice
10	Performance characteristics of Pelton wheel turbine.
11	Performance characteristics of Francis turbine.
12	Performance characteristics of Kaplan turbine.
13	Performance test on reciprocating pump and centrifugal pump

VIRTUAL LAB

	http://www.vlab.co.in/broad-area-mechanical-engineering
	http://vlabs.iitb.ac.in/vlab/labsme.html
	http://www.vlab.co.in/participating-institute-iit-kharagpur

B. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	3	–
CO2	2	2	2	2	–	–	–	–	–	–	3	–
CO3	2	2	2	2	–	–	–	–	–	–	3	–
CO4	2	2	2	2	–	–	–	–	–	–	3	–
CO5	2	2	2	2	–	–	–	–	–	–	3	–

C. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	2	–	3
CO2	2	–	3
CO3	2	–	3
CO4	2	–	3
CO5	2	–	3

Note: On the basis of mapping of COs with POs, this course is related to Skill Development and Entrepreneurship

Code:	FUNDAMENTALS OF MARKETING-I	Credit [L T P:]

Course Outcomes:

On successful completion of the course the learner will be able to

CO-1	UNDERSTAND the various concepts, terms in marketing and the various company orientations towards the market place.
CO-2	APPLY the concept and theories of Segmentation, targeting and positioning to the actual market situations
CO-3	EXPLAIN the concept of marketing mix and DEVELOP the applications for real world market offerings
CO-4	EVALUATE various Product Mix and Price Mix of real world market offering
CO-5	EVALUATE various Place Mix and Promotion Mix of real world market offering

COs AND POs Mapping

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO101	2	2	1	2	1	2	-
CO102	1	3	-	2	1	-	-
CO103	1	-	-	3	1	-	1
CO104	1	1	2	-	-	-	1
CO105	1	1	2	-	1	1	-

OUTLINE OF THE COURSE:

Unit No.	Title of the unit	Time required for the unit(Hours)
1.	**Introduction to Market and Marketing**	8
2.	**Market Segmentation**	8
3.	**Marketing Mix**	8
4.	**Product Mix and Price Mix**	8
5.	**Place Mix and Promotion Mix**	8

Detailed Syllabus

Unit	Contents
1.	**Introduction to Market and Marketing**
	Meaning and Definition of Market; Classification of Markets; Marketing Concept: Traditional and Modern; Importance of Marketing; Functions of Marketing: Buying, Selling, Assembling, Storage, Transportation, Standardization, Grading, Branding, Advertising, Packaging, Risk Bearing, Insurance, Marketing Finance, Market Research and Marketing Information.; Selling vs. Marketing
2.	**Market Segmentation, Targeting & Positioning**
	Market Segmentation: Introduction, Meaning and Definition, Importance, Limitations; Bases for Segmentation. Targeting and Positioning strategies.
3.	**Marketing Mix**
	Marketing Mix: Introduction, Meaning & Definition; Elements of Marketing Mix- Product, Price, Place and Promotion; Importance of Marketing Mix
4.	**Product Mix and Price Mix**
	(A) Product Mix: Meaning and Definition , Product Line and Product Mix, Product Classification, Product Life Cycle, Factors Considered for Product Management **(B) Price Mix**: Meaning and Definition , Pricing Objectives, Factors Affecting Pricing Decision , Pricing Methods
	Place Mix and Promotion Mix

	(A) Place Mix: Meaning and Definition of Place Mix , Importance , Types of Distribution Channels – consumer goods and Industrial Goods, Factors Influencing selection of Channels **(B) Promotion Mix**: Meaning of Promotion Mix, Elements of Promotion Mix- Personal Selling, Public Relation and Sales Promotion, Factors Affecting Market Promotion Mix, Promotion Techniques or Methods

Recommended Study Material

S. No	Title of the Book	Authors	Publication
01	Marketing Management	Philip Kotler	Pearson Publication
02	Marketing Management	Rajan Saxena	McGraw Hill Education
03	Principles of Marketing	Philip Kotler	Pearson Publication
04	Sales & Distribution Management	Tapan K Panda	Oxford Publication
05	Advertising Management	Rajiv Batra	Pearson Publication
06	Retail Management	Swapna Pradhan	McGraw Hill Publication
07	Retail Management	Gibson Vedamani	Jayco Publication
08	Marketing Management	V. S. Ramaswamy& S. Namakumari	Macmillan Publication

Skill Development Activities:

(These activities are only indicative; the Faculty member can innovate)

1. Visit any website and list the promotion strategy of a sponsoring company.

2. Find out the promotion tools of any company.

3. Observe the Distribution Network of a Company

4. List out Product Line of a company and note line modernization or deletion.

5. Draw a Product Life Cycle with regard to a particular product of a company and observe its extension.

FIFTH SEMESTER

Code: BMECME5101	DESIGN OF MACHINE ELEMENTS-I	3 Credits [LTP: 3-0-0]

Course Outcomes

The student will be able to:

CO1 Analyze the process to identify the material for respective output, know about the basic knowledge of fits & tolerances.

CO2 Analyze the design on a Pin, cotter and keyed joints, Design of screw fastening.

CO3 Illustrate the design the bending stress in beam, leaf spring.

CO4 Recommend the designing of shafts subjected to combine twisting moment and bending moment.

CO5 Analyze the design procedure for Shaft under combined stresses, Screw fasteners subjected to eccentric loading.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Design processes and Material selection	7
2.	Design for strength:	7
3.	Design of members in Bending:	8
4.	Design of members in torsion	7
5.	Combined Stresses	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Design processes and Material selection**
	• Introduction of Unit • Materials: Properties and IS coding of various materials, Selection of material from properties and economic aspects. • Manufacturing aspects in Design: Selection of manufacturing processes on the basis of design and economy, Influence of rate of production, standard size, Influence of limits, fits tolerances and surface finish. Change in the shape of the designed element to facilitate its production, Design of castings, working drawing. • Conclusion and Summary of Unit
2.	**Design for strength**
	• Introduction of Unit • Design for strength: Allowable stresses, detailed discussion on factor of safety (factor of ignorance): Stress concentration. Causes & mitigation. Introduction of various design considerations like strength, stiffness, weight, cost, space etc. Concept of fatigue failures. • Design of machine elements subjected to direct stress, Pin, cotter and keyed joints, Design of screwfastening. • Conclusion and Summary of Unit
3.	**Design of members in Bending**
	• Introduction of Unit • Bending stress in straight & curved beam, springs, Laminated springs, stress and deflection equation, spring design – trial and error method, Leaf spring design, Multi leaf spring, Nipping in leaf spring, Materials used for leaf spring manufacturing, Design against fluctuating load. • Types of levers & working principle, Lever Manufacturing & Applications, Various sections for levers, Design of Levers. • Conclusion and Summary of Unit
4.	**Design of members in torsion**
	• Introduction of Unit • Transmission shafts, Shafts design on strength basis, ASME code for shaft design, Design consideration & causes of failure of shaft, Shaft subjected to combine twisting moment and bending moment. Design of hollow shaft on strength basis & Torsional rigidly basis. Flexible shafts, Shaft subjected to fluctuating loads • Shaft couplings ;Design procedure and applications of Keys ,Muff couplings ,Clamp coupling, Rigid Flange

	coupling, Rigid flange couplings, Bushes-pin flexible coupling, Oldham coupling,Universal coupling, Design of lateral rigidity • Conclusion and Summary of Unit
5.	**Combined Stresses**
	• Introduction of Unit • Design of Shaft under combined stresses. Design procedure for Shaft under combined stresses. Bolted joint-simple analysis. Eccentrically loaded bolted joints in shear, Eccentric loads perpendicular to axis of bolts. Eccentric loads on a bracket with circular base, Bolted joints under fluctuating load, Deflections of shapes in combined torsion and bending, Deflection of shafts in combined, Bending and axial Bending • Screw fasteners subjected to eccentric loading. Eccentric loading of riveted joints, welded joints, threaded joints, Brackets, Bolts & bending • Conclusion and Summary of Unit

C. RECOMMENDED STUDY MATERIAL:

Sr. No	Reference Book	Author	Edition	Publication
1.	Introduction to Machine Design	Bhandari, V.B.,	Latest	Tata McGraw-Hill
2.	A Text book of Machine Design	Khurmi, R.S., Gupta, J.K.,	Latest	S. Chand Publication.
3.	Design of Machine element	Bhandari, V.B.,	Latest	Tata McGraw-Hill
4.	Mechanical Engineering Design	Shigley, J.E.,	5th Ed.	---
5.	Machine Design Databook	Lingaiah, K.	Latest	Tata McGraw-Hill
6.	Design of Machine Elements	C.S.Sharma& Kamlesh	Latest	Prentice Hall of India Pvt. Ltd.
Important Web Links				
1	https://nptel.ac.in/courses/112105124/			
2	en.wikipedia.org/wiki/Machine_element			

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	3	2	2	–	–	–	–	–	–	–	–
CO3	2	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	3	3	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	3
CO2	–	2	3
CO3	–	2	3
CO4	–	2	3
CO5	–	2	3

Note: On the basis of mapping of COs with POs, this course is related to Employability

Code: BMECME5102 MANUFACTURING SCIENCE AND TECHNOLOGY 3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Illustrate the functioning of single point cutting tool and aspects.

CO2 Analyze the mechanical measuring tools and their functioning.

CO3 Examine the importance of CNC Machine and its advantages and limitation.

CO4 Apply the design of lathe bed and its strength constraint.

CO5 Analyze the finishing processes and High Velocity Forming Methods.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Theory of Metal Cutting	9
2	Precision Methods	7
3	Numerical Control of Machine Tools	7
4	Design of Machine Tool Element	8
5	Finishing Processes and High Velocity Forming Methods	8

B. DETAILED SYLLABUS

Unit	Unit Details
1	**Theory of Metal Cutting**
	• Introduction of Unit • **Theory of Metal Cutting**, Mechanics of chip formation single point cutting tool, method of machining, type of chips, determination of shear angle, undeformed chip thickness, force relation, Energy considerations in metal cutting, Tool wear and tool life, Tool material. • **Design of Single Point Cutting Tools:** Introduction; functions of various tool angles; design of single point turning tool; parting tool; empirical determination of force components. • **Design of Multipoint Cutting Tool:** Introduction; angle of contact; force analysis; approach through dimensional analysis. • Conclusion of Unit including Real Life application
2	**Precision Methods**
	• Introduction of Unit • **Precision Measurement and Instruments:** Standards of linear measurements; linear and angular measurements; screw thread measurement; measurement of effective diameter, pitch and thread angles; Gear measurement, measurement of tooth profile, tooth thickness and pitch, Measurement of surface roughness, Comparators types. • **Jigs and Fixtures: -**Introduction, definition and difference; usefulness of jigs and fixtures; materials used; principles and methods of location; clamping elements; assembly fixtures. • Conclusion of Unit including Real Life application
3	**Numerical Control of Machine Tools**
	• Introduction of Unit • **Numerical Control of Machine Tools**; Introduction, Numerical Control & its growth, NC Machines tools, Axes of NC Machines, Classification of NC System, CNC, DNC and Machining Centre. Machine Control unit, NC tools & Tool changer. Manual Part Programming; coordinate, Feed, Speed & Tool. • Conclusion of Unit including Real Life application
4	**Design of Machine Tool Element**
	• Introduction of Unit • **Design of Lathe bed**, Material and construction feature, various bed section, designing for torsional rigidity, Theoretical aspect of design of guide ways. • **Press Tool Design**: Introduction, Press operation, classification of power presses, Press selection, press working terminology, working of cutting die. • Conclusion of Unit including Real Life application
5	**Finishing Processes and High Velocity Forming Methods**

	• Introduction of Unit • **Finishing Processes:-** Principle of operation, advantages, limitations and applications of: Grinding, Honing, Lapping, Buffing, Burnishing, Polishing. • **High Velocity Forming Methods:** Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming • Conclusion of Unit including Real Life application

C. RECOMMENDED STUDY MATERIAL:

Sr.No	Book	Author	Edition	Publication
a. Reference Books				
1.	Manufacturing Process I & II -	Bawa,	Latest	Tata McGraw Hill Publication
2.	Materials and Process Manufacturing.	E. Paul DeGarmo, J.T. Black, Ronald A. Kohser,	Latest	John Willey Publication Ninth edition
3.	Jig and Fixture Design	Erik K. Henriksen	Latest	Manual - Industrial Press
4.	Tool Design	Donaldson, Lecain, Goold	Latest	Tata McGraw Hill
5.	A Textbook of Production Engineering	P. C. Sharma	Latest	S. Chand & Company. Ltd.
6.	CAD/CAM	Grover M. P.	Latest	Tata McGraw hill Publication
7.	Advanced Machining Processes	V. K. Jain	Latest	Allied Publication
b. Important Web links				
1	https://nptel.ac.in/courses/112107144/			
2	https://en.wikipedia.org/wiki/Manufacturing Science and Technology			

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	3	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	2	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	2	–	–
CO2	2	–	–
CO3	2	–	–
CO4	2	–	–
CO5	2	–	–

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME5103	AUTOMOBILE AND IC ENGINES	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Examine the nomenclature and performance of IC engine, characteristics of SI and CI engines and components.

CO2 Analyze the fuel injection system like Electronic Injection Systems Multi-Point Fuel Injection (MPFI) System, Injection Timing, Electronic Diesel Injection System and also lubrication and ignition system in engine.

CO3 Categorize the transmission system, suspension, steering system like gear box, gears & gear ratios, types of gear boxes, Automatic transmission system; overdrive, propeller shaft, universal joints, Differential, Steering layout, tyres, tyre materials.

CO4 Investigate the automotive electrical, air conditioning and safety systems.

CO5 Analyze the characteristics, components and functioning of battery charging system.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	I C Engines	7
2	Engine Operating Systems	8
3	Chassis Systems	7
4	Automotive Systems	7
5	Chassis & Body	7

B. DETAILED SYLLABUS

Unit	Unit Details
1	**I C Engines:**
	• Introduction of Unit • **Introduction:** Classification, Engine nomenclature, engine operating and performance parameters, Valve timing diagram of SI & CI Engines, Comparison of SI and CI engine. • **Engine Components, function & Materials:** piston assembly; connecting rod; crankshaft; cylinder head; cylinder block; flywheel, ports; valves; valve actuating mechanism; cams; camshaft drives • **Latest Development in IC Engine:** Bio Fuel Operated Engine, Direct Injection Engine, Low Temperature Diesel Combustion Engine, Dual Fuel Technology, VCR Engine, VVT Engine, HCCI Engine, Hybrid Vehicle, Fuel Cell Technology • Conclusion of Unit including Real Life Application
2	**Chassis & Body**
	• Introduction of Unit • Introduction to Automobile: Historical Development of automobiles, classification of automobiles, Layout of Automobile Vehicle, their constructional features and materials, Current developments in vehicles. • Chassis, Frame & Body: Types of frames, engine location, Comparison of front and rear mounting of engine, arrangement of clutch assembly, gearbox, and propeller shaft with universal joints. front and rear differentials, rear, front and four wheel drives, their relative merits, types of chassis, pre requirements of body, types of bodies & their construction, aerodynamic considerations in body profiling, ergonomical considerations, defects in frames and body.. • Conclusion of Unit including Real Life application
3	**Engine Operating Systems :**
	• Introduction of Unit • **Fuel Injection:** Classification of Injection Systems, Injection in SI Engine, Electronic Injection Systems Multi-Point Fuel Injection (MPFI) System, Sequential Fuel injection, Injection Timing, Electronic Diesel Injection System. • **Lubrication:** Functions of Lubrication, Types of lubrication, Properties, Rating and Classification of lubricating oil, Additives. • **Ignition:** Energy requirement for ignition, requirements of an ignition system, modern ignition systems (TCI and CDI), Triple Spark Technology, distributor-less ignition system, firing order, Ignition timing. • Conclusion of Unit including Real Life application
4.	**Chassis Systems**
	• Introduction of Unit

	• **Transmission System:**Functions of gear box, gears & gear ratios, types of gear boxes, Automatic transmission system; overdrive, propeller shaft, universal joints.Differential. • **Suspension System:** Principle, type of suspension system, conventional and independent front and rear axle, rubber and air suspensions, shock absorbers. • **Steering System:** Steering layout, types of steering gears, checking wheel alignment and steering geometry • **Wheels &Tyres:** Types of wheels, types of tyres, tyre materials, tyre designations and factors affecting tyre life. • **Braking System:**Principle and working of various types of brakes, anti-lock brake systems (ABS). • Conclusion of Unit including Real Life application
5.	**Automotive systems**
	• Introduction of Unit • **Automotive Electrical System:**Battery System and Charging, Alternator construction, regulation and rectification. Ignition System: magneto and coil ignition systems, System components and requirements, automotivelighting: Wiring systems. • **Automotive Air Conditioning:**Introduction, Air conditioning system Components, Refrigerants, Fault Diagnosis. • **Automotive Electronics:**Fundamentals of Automotive Electronics, Sensors, Actuators, microprocessor and micro computer applications in automobiles, Major Applications, Components for engine management system. • **Automotive Safety:** Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System) etc. • Conclusion of Unit including Real Life application

C. RECOMMENDED STUDY MATERIAL

S.No.	Book	Author	Edition	Publication
Reference Books				
1	Fundamentals of Internal Combustion Engines	Gupta H.N.,	Latest	Prentice Hall of India
2	Internal Combustion Engines	Mathur& Sharma,	Latest	Dhanpat Rai & Sons
3	Automotive Engines	William H.Crouse,	Latest	McGraw-Hill.
4	Internal Combustion Engines	Ganesan.V	Latest	Tata McGraw-Hill
5	Automobile Engineering	Narang G.B.S	2001	Khanna Publishers, Delhi
6	Course in Automobile Engineering	Sharma R. P.	Latest	Dhanpat Rai & Sons
Important Web Links				
https://nptel.ac.in/courses/112104033/ https://swayam.gov.in/nd1_noc20_me42 http://web.iitd.ac.in/~ravimr/courses/mel345/classification.pdf				

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	2	3	2	2	–	–	–	–	–	–	–	–
CO3	2	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	3	3	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME5104	HEAT AND MASS TRANSFER	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the basic concepts of heat transfer through conduction, convection and radiation.

CO2 Apply the concept of heat conduction through extended surfaces and transient heat conduction.

CO3 Analyze the heat transfer through forced and natural convection over flat plate, sphere and cylinder.

CO4 Recommend the design aspects of various types of heat exchange and their applications

CO5 Analyze the heat transfer by radiation from grey and black body and to analyze the concepts of mass transfer.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Basics of Heat and Mass Transfer	7
2.	Fins and Transient Conduction	7
3.	Forced Convection and Natural Convection	8
4.	Heat Exchanger:	7
5.	Thermal Radiation and Mass Transfer	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Basics of Heat and Mass Transfer**
	• Introduction of Unit • **Introduction to Heat Transfer:** Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. **Fourier's law of heat conduction:** Thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity. **Conduction:** General 3-Dimensoinal conduction equation in Cartesian; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; heat conduction through composite walls; critical thickness of insulation. • Conclusion of Unit including Real Life application
2.	**Fins and Transient Conduction**
	• Introduction of Unit • **Fins:** Heat transfer from extended surfaces, Types of fins, governing equation, Fin performance, fin efficiency, fin effectiveness, overall fin effectiveness. Fins of uniform cross-sectional area. • **Transient Conduction:** Transient heat conduction; Lumped capacitance method. • Conclusion of Unit including Real Life application
3.	**Forced Convection and Natural Convection**
	• Introduction of Unit • **Forced Convection:** Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Flow over a flat plate; Flow across a single cylinder and a sphere. • **Natural Convection:** Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical plates and cylinders, horizontal plates and cylinders. • Conclusion of Unit including Real Life application
4.	**Heat Exchanger:**
	• Introduction of Unit • **Heat Exchanger:** Different types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger, N.T.U. method. • Conclusion of Unit including Real Life application
5.	**Thermal Radiation and Mass Transfer**

	• Introduction of Unit • Thermal Radiation: Basic radiation concepts, Plank distribution law, Krichoff's law; Wein's displacement law, Stefan Boltzmann law. Radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies. • Mass Transfer:- Introduction, Modes of Mass transfer, Concentrations, Velocities and fluxes, Concentrations, Fick's Law. • Conclusion of Unit including Real Life application

C. RECOMMENDED STUDY MATERIAL:

Sr. No.	Book	Author	Edition	Publication
Reference Books				
1.	Heat Transfer	S.P. Sukhatme,	2019	Universities Press (India)
2.	Heat and Mass Transfer	R.K. Rajput	Latest	S.Chand& Company Ltd
3.	Heat and Mass Transfer	D.S.Kumar	Latest	S.K.Kataria& Sons
4.	Heat Transfer	J.P. Holman,	2019	McGraw Hill,
5.	Heat and Mass Transfer	E.R.G. Eckert and Robert M. Drake	Latest	McGraw Hill,
6.	Fundamentals of Heat and Mass transfer	Kothandraman. C.P.,	2019.	New Age International
Important Web Links				
1	https://nptel.ac.in/courses/112108149/			
2	https://nptel.ac.in/courses/112101097/			

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	1	–	–	–	–	–	–	–	–
CO2	3	3	1	1	–	–	–	–	–	–	–	–
CO3	2	2	1	1	–	–	–	–	–	–	–	–
CO4	3	2	1	1	–	–	–	–	–	–	–	–
CO5	3	2	1	1	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	3
CO2	–	2	3
CO3	–	2	3
CO4	–	2	3
CO5	–	2	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMEEME5112	SENSORS AND CONTROL	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Understand the basic principles of control system.

CO2 Apply characteristics and learning the concepts of time response analysis.

CO3 Understand and apply concepts of frequency response analysis.

CO4 Recommend the suitable thermal sensors for different measurement applications

CO5 Illustrate and understand the principle of various mechanical and electrical sensors used in industrial applications.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	The Control System	8
2.	Time Response analysis	9
3.	Control System Components	9
4.	Thermal Sensors	8
5.	Mechanical and Electrical Sensors	9

B. DETAILED SYLLABUS

Unit	Unit Details
1	**The Control System**
	• Introduction to unit • Open loop & closed control; Servomechanism, Transfer functions, Block diagram algebra • Signal flow graph, Mason's gain formula Reduction of parameter variation and effects of disturbance by using negative feedback • Conclusion and Summary of Unit
2	**Time Response analysis**
	• Introduction of Unit • Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants • Design specifications of second order systems: Derivative error, derivative output, integral error, P-I-D controller, applications and case studies. P-I-D compensations, design considerations for higher ordersystems, performance indices • Conclusion and Summary of Unit
3	**Control System Components**
	• Introduction of Unit • Concept of stability and necessary conditions, • Routh-Hurwitz criteria and limitations. • Root Locus Technique: The root locus concepts, construction of root loci, Bode Plot, and Nyquist Criterion • Conclusion and Summary of Unit
4	**Thermal Sensors**
	• Introduction of Unit • Definition of Temperature: Thermal Energy, absolute and relative Temperature, Metal resistance versus temperature devices: Resistance versus Temperature Approximations, Resistance-Temperature Detectors (RTD), Thermistors • Thermocouples: Thermoelectric Effects, Thermocouple Characteristics, Thermocouple Sensors, Other thermal sensor: Bimetal Strips, Thermometers and its types, Solid-State Temperature Sensor, Design considerations and optical sensors • Conclusion and Summary of Unit
5	**Mechanical and Electrical Sensors**
	• Introduction of Unit • Displacement, Location, or Position Sensors: Resistive-, Capacitive-, and Inductive Sensors, Variable-Reluctance Sensors, LVDT, Level Sensors, Metal Strain Gauges and Semiconductor Strain Gauges (SGs) ,

	Load Cells and sensors in modern machine tools. • Motion sensors: Types of Motion, Accelerometer Principles, Types of Accelerometers, • Pressure sensors: Pressure Principles, Pressure Sensors (p > 1 atmosphere), Pressure Sensors (p < 1 atmosphere) and Flow sensors • Case studies on use of sensors in daily life • Conclusion and Summary of Unit

C. RECOMMENDED STUDY MATERIAL:

Sr. No	Reference Book	Author	Edition	Publication
1.	Process Control Instrumentation Technology	Curtis D. Johnson	Latest	Prentice Hall International Edition
2.	Measurement, Instrumentation, and Sensors Handbook	John G. Webster	Latest	CRC – Press – Taylor and Francis Group
3.	Introduction to Instrumentation and Measurement	Robert B. Northrop	3rd Edition	CRC – Press – Taylor and Francis Group
Important Web Links				
1	https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf			
2	*en.wikipedia.org/wiki/sensor and control*			

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	2	–	–	–	–	–	–	–	–
CO2	2	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	2
CO2	–	2	2
CO3	–	2	2
CO4	–	2	2
CO5	–	2	2

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMEEME5111	INDUSTRIAL ENGINEERING	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student will be able to:

CO1 Define and apply productivity concept to engineering applications

CO2 Demonstrate techniques to increase productivity

CO3 Describe the implementation of work and time study at a workplace

CO4 Assess the importance of ergonomics for design of machines

CO5 Apply the concepts of aesthetics at interiors and exteriors of a workplace

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Productivity and Work Study	7
2.	Quality and Inventory Control	8
3.	Production Planning & Control	7
4.	Manufacturing Cost Analysis	7
5.	Plant Layout and Material Handling	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Productivity and Work Study**
	• Introduction of Unit • Productivity: Introduction, definition, various method of measurement, factors effecting productivity, strategies for improving productivity. • Work Study: Objectives, Method study, Principle of motion economy, Techniques of method study - Various charts, THERBLIGS, Work measurement - various methods, time study, determining time, Work sampling, Simple Numerical. • Conclusion of Unit including Real Life Application
2.	**Quality and Inventory Control**
	• Introduction of Unit • Quality control: Definition of quality, Various approaches, Concept of quality assurance systems, Costs of quality, Statistical quality Control (SQC), Variables & Attributes, X, R, P & C - charts, Acceptance sampling, OC - curve, Concept of AOQL, Sampling plan - Single, Double & sequential, Introduction to TQM & ISO - 9000. • Inventory control: Inventory control models - Inventory control models - Economic order quantity (EOQ), Economic batch quantity (EBQ) with & without shortage, Purchase discounts, Sensitivity analysis, Inventory control systems - P,Q,Ss Systems, Service level, Stock out risk, determination of order point & safety stock, Selective inventory control - ABC, FSN, SDE, VED and three dimensional, Numericals. • Conclusion of Unit including Real Life Application
3.	**Production Planning & Control**
	• Introduction of Unit • Production Planning & Control: Production Planning & Control: Introduction to Forecasting - Simple & Weighted moving average methods, Objectives & variables of PPC, Aggregate planning - Basic Concept, its relations with other decision areas, Decision options - Basic & mixed strategies, Master production schedule (MPS), Scheduling Operations, Various methods for line & intermittent production systems, Gantt chart, Sequencing – Johnson algorithm for n-Jobs-2 machines, n- Jobs-3 machines, 2 Jobs n-machines, n- Jobs m-machines Various means of measuring effectiveness of PPC, Introduction to JIT, Numericals. • Conclusion of Unit
4.	**Manufacturing Cost Analysis**
	• Introduction of Unit • Manufacturing Cost Analysis: Fixed & variable costs, Direct, indirect & overhead costs, & Job costing, Recovery of overheads, Standard costing, Cost control, Cost variance Analysis - Labour, material, overhead in volume, rate & efficiency, Break even Analysis, Marginal costing & contribution, Numericals • Conclusion of Unit
5.	**Plant Layout and Material Handling**

	• Introduction of Unit • Plant Layout and Material Handling: Plant location, site selection- Plant layout types, need, factors influencing the layout - Tools and techniques for developing layout, process chart, flow diagram, string diagram, Template and Scale models- Layout Planning procedure- Assembly line balancing. Material Handling, scope and importance- Types of material handling systems-factors influencing material handling- methods of material handling. • Material Requirements Planning (MRP): Introduction, MRP system structure, master production schedule (MPS), bill of materials, inventory status, MRP Procedure. • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL

Sr. No	Reference Book	Author	Edition	Publication
1	Industrial Engineering and Management	Khanna O. P	Latest	Khanna publishers
2	Principles and practice of Management	Prasad, L.M.	Latest	Sultan Chand & Sons
3	Works Organisation& Management	Sushil Kumar Basu, K. C. Sahu, N. K. Datta	Latest	Oxford & IBH
4	Principles of Industrial Organization	Dexter S. Kimball	Latest	Read Books
5	Essentials of Industrial Management	Lawrence L. Bethel	Latest	McGraw-Hill.
6	Engineering Economics,	Riggs, J.L., Bedworth, D.J.	Latest	Tata McGraw-Hill.
Important Web Links				
1	https://nptel.ac.in/courses/112/107/112107142/			
2	https://nptel.ac.in/courses/112/107/112107292/			

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	–	–	–	–	–	2	–	–	2	–
CO2	2	2	–	–	–	–	–	3	–	–	2	–
CO3	2	2	–	–	–	–	–	2	–	–	2	–
CO4	3	3	–	–	–	–	–	2	–	–	2	–
CO5	3	2	–	–	–	–	–	2	–	–	2	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	2
CO4	–	–	2
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability

Code: BMEEME5113	PRODUCT DESIGN AND DEVELOPMENT	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student will be able to:

CO1 Examine the importance of new product and their importance.

CO2 Identify the design problems of new product and their solution.

CO3 Assess the various concept selection of new product and apply on a new product.

CO4 Examine the management technique of a new product.

CO5 Evaluate the reliability of a new product using Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF.

B. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Product Design and Development	5
2.	Morphology of Design	4
3.	Generation of Alternatives and Concept Selection	5
4.	Management of New Product	5
5.	Reliability	5

C. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Product Design and Development**
	• Introduction of Unit • Importance of new product-Definition-importance-Development Process. Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology. Design definitions, the role and nature of design, old and new design methods, Design by evolution. Examples such evolution of bicycle, safety razor etc.Physical reliability & Economic feasibility of design concepts. New product development process and organization. • Conclusion of Unit including real life applications
2.	**Morphology of Design**
	• Introduction of Unit • Need analysis- Problem Formulation: Establishing economic existence of need, Need Identification and Analysis, Divergent, transformation and convergent phases of product design. Design criteria, functional aspects. Aesthetics, ergonomics, form (structure). Shape, size, color. Mental blocks, Removal of blocks. • Conclusion of Unit including real life applications
3.	**Generation of Alternatives and Concept Selection**
	• Introduction of Unit • **Generation of Alternatives and Concept Selection:** Concept generation- a creative process, Creativity,Road Elects to creative thinking-Fear of criticism and Psychological set. Tools of creativity like brain storming, Analogy, Inversion etc., Creative thinking Process. Brainstorming &Synectics. Morphological techniques. Utility concept, Utility value, Utility index. Decision making under multiple criteria. Economic aspects of design. • Conclusion of Unit including real life applications
4	**Management of New Product**
	• Introduction of Unit • Preliminary & detailed design- Design Review: Preliminary design- Identification of subsystems, Subsystem specifications, Compatibility. Detailed design of subsystems, component design, Preparation of assembly drawings. Management of New Product – development and Launch: New Product Management's Challenges Maintaining focus, Promotion of Right Culture, Management of Creativity, Top Management attention. • Conclusion of Unit including real life applications
5.	**Reliability**

	• Introduction of Unit • Reliability considerations, Bath tub curve, Reliability of systems in series and parallel. Failure rate, MTTF and MTBF. Optimum spares from reliability consideration. Design of displays and controls, Man-Machine interface, Compatibility of displays and controls. Ergonomic aspects. • Conclusion of Unit including real life applications

D. RECOMMENDED STUDY MATERIAL:

Sr. No	Book	Author	Edition	Publication
a. Reference Books				
1.	Product Design &Manufacturing	A.K.Chitab&R.C.Gupta	Latest	PHI (EEE).
2.	Product Design & Decision Theory	M.K. Starr	Latest	Prentice Hall
3.	Quality Control & Reliability Analysis	Bijendra Singh	Latest	Khanna Publications.
4.	The Technology of Creation Thinking	R.P. Crewford	Latest	Prentice Hall
5.	Engineering: An Introduction to Creativeprofession	G.C. BeakleyHw leach	Latest	Macmillan
6.	Industrial Design In Engineering – Amarriage of Techniques	Charles H .Flurscheim	Latest	The Design Council - London
b. Important Web links				
https://nptel.ac.in/courses/112/107/112107217/ https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/lecture-notes				

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	2	–	–
CO2	1	–	–
CO3	2	–	–
CO4	2	–	–
CO5	2	–	–

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME5201	MANUFACTURING TECHNOLOGY LAB-II	1 Credit [LTP: 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Perform operations on lathe by orthogonal and oblique and also calculate the machining time.

CO2 Perform operation on lathe for making of bolt and also perform operation of gear cutting on milling.

CO3 Analyze the different tools, angles and jigs and fixtures and their uses.

CO4 Perform operation on tool grinder and also determine shear angle on lathe machine.

CO5 Perform operation on shaper and determine various length on Vernier.

A. LIST OF EXPERIMENTS:

1.	Study and Practice of Orthogonal & Oblique Cutting on a Lathe.
2.	Machining time calculation and comparison with actual machining time while cylindrical turning on a Lathe and finding out cutting efficiency.
3.	Bolt (thread) making on Lathe machine
4	Gear cutting on Milling machine.
5	Study of different types of tools and its angles & materials.
6	Experiment on jigs/Fixtures and its uses
7	Tool grinding (to provide tool angles) on tool-grinder machine
8	Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine
9	Machining a block on shaper machine.
10	Measurement of Length, Height And Diameter By Vernier Calipers, Vernier Height Gauge And Micrometer
11	Measurement of Bores Using Dial Bore Indicator
12	Angle And Taper Measurement Using Bevel Protractor And Sine Bar
13	Measurement of Thickness of Gear Teeth By Vernier Tooth Caliper
14	Flatness of Surface Plate By Using Spirit Level

VIRTUAL LAB

1	http://www.vlab.co.in/broad-area-mechanical-engineering
2	http://www.vlab.co.in/ba-nptel-labs-mechanical-engineering
3	http://vlabs.iitb.ac.in/vlab/labsme.html

B. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	2	2	3	2	–	–	–	–	–	–	–	–

C. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Code: BMECME5202	AUTOMOBILE AND IC ENGINE LAB	1 Credit [LTP: 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Illustrate the construction and working of various types of clutches with their application

CO2 Analyze design aspects of various types of steering system

CO3 Demonstrate the working of automotive transmission system

CO4 Analyze various automotive braking system and their application

CO5 Apply the test on petrol and diesel engine to determine their operating characteristics

A. LIST OF EXPERIMENTS:

1.	To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches. a. Coil-Spring Clutch b. Diaphragm – Spring Clutch. c. Double Disk Clutch.
2.	To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems. a. Multi-cylinder: Diesel and Petrol Engines. b. Engine cooling & lubricating Systems. c. Engine starting Systems. d. Contact Point & Electronic Ignition Systems.
3.	Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle Performance
4.	To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres& wheels. a. Various Types of Bias & Radial Tyres. b. Various Types of wheels.
5.	To study and prepare report on the constructional details, working principles and operation of different Automotive Transmission systems.
6.	Drive Lines & Differentials. a. Rear Wheel Drive Line. b. Front Wheel Drive Line. c. Differentials, Drive Axles and Four Wheel Drive Line
7.	Trouble shooting in braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system and its testing.
8.	To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems. a. Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering. b. Power steering Systems, e.g. Rack and Pinion Power Steering System
9.	Trial on a petrol engine and calculation of air/fuel ratio, volumetric, thermal and mechanical efficiencies.
10.	Trial of a Diesel engine and calculation of air/fuel ratio, volumetric, thermal and mechanical efficiencies.
11.	Study of cooling systems.
12.	Study of lubrication systems

VIRTUAL LAB

	http://vlabs.iitkgp.ernet.in/rtvlas/
	https://www.iitg.ac.in/mech/lab_ice.php
	https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/labs/

B. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	2	2	2	2	–	–	–	–	–	–	–	–

C. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME5203	HEAT TRANSFER LAB	1 Credit [LTP : 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the heat conduction through insulating powder and metal rod.

CO2 Analyze the thermal conductivity of liquid and temperature distribution in extended surface.CO3

Apply the Stefan Boltzmann constant of heat transfer and determine the emissivity of plate.

CO4 Analyze the heat transfer coefficient for heated vertical cylinder and critical heat flux in saturated pool boiling.

CO5 Apply the performance of simple heat pipes and analyze the effectiveness of LMTD between parallel and counter flow.

B. LIST OF EXPERIMENTS:

1.	To Determine Thermal Conductivity of Insulating Powders.
2.	To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
3.	To Measure the thermal Conductivity of Liquid.
4.	To determine the transfer Rate & Temperature Distribution for a Pin Fin.
5.	To Measure the Emissivity of the Test plate Surface.
6.	To Determine Stefan Boltzmann Constant of Radiation Heat Transfer.
7.	To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
8.	To Determine Critical Heat Flux in Saturated Pool Boiling.
9.	To Study Performance of Simple Heat Pipes.
10.	To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers
11.	To Find the Heat transfer Coefficient in Forced Convection in a tube.
12.	To study the rates of heat transfer for different materials and geometries

VIRTUAL LAB

□	http://htv-au.vlabs.ac.in/
□	http://vlabs.iitb.ac.in/vlab/chemical/exp8/index.html
□	https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab
□	https://www.iitk.ac.in/me/heat-transfer-laboratory

C. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	2	2	2	2	–	–	–	–	–	–	–	–
CO4	2	2	2	2	–	–	–	–	–	–	–	–
CO5	2	2	2	2	–	–	–	–	–	–	–	–

D. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME5204 INDUSTRIAL ENGINEERING AND ROBOTICS LAB 1 Credit [LTP: 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Determine standard time for job preparation.

CO2 Prepare flow process chart, operation process chart and man-machine charts for an existing setup and development of animproved process.

CO3 Detect through fixed sensors for various robotic applications.

CO4 Determine 5 Axis Robotic Arm movement and its degree of rotation..CO5

Detect distance (10cm to 80 cm) with infrared object detector.

A. LIST OF EXPERIMENTS:

1.	Determination of time standard for a given job using stopwatch time-study.
2.	Preparation of flow process chart, operation process chart and man-machine charts for an existing setup and development of an improved process.
3.	Study of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic viewpoint.
4.	To design a sampling scheme based on OC curve.
5.	ROBOTICS: To detect the sensor scanning systems to overcome limitation of fixed sensors on various robotic applications, ultrasonic sensor, laser range finders, infrared detectors and miniature.
6.	To detect objects with infrared ray detector.
7.	To determine object distance (3cm – 300cm).
8.	To detect distance (10cm to 80 cm) with infrared object detector.
9.	To determine 5 Axis Robotic Arm movement and its degree of rotation.
10.	To study various Robotic Arm Configurations.
11.	To study Pick and Place Robot.
12.	Experiment on transfer line/material handling.
13.	Experiment on study of system devices such as motors and feedback devices.

Virtual Lab
http://www.vlab.co.in/broad-area-mechanical-engineering
http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/refigeration/labs/exp1/index.php

B. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	2	2	2	2	–	–	–	–	–	–	–	–
CO3	2	2	2	2	–	–	–	–	–	–	–	–
CO4	3	3	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

C. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill development

SIX SEMESTER

Code: BMECME6201 INDUSTRIAL TRAINING SEMINAR - II 12 Credits [LTP: 0-0-24]

Course Outcomes

CO1 Illustrate the effectiveness of report reading.
CO2 Examine well recognized research papers from reputed journals, conferences.
CO3 Analyze the method of searching of research paper.
CO4 Analyze the abstract and methodologies in the research paper
CO5 Illustrate the techniques to create a review paper.

OBJECTIVE: To expose engineering students to technology development at workplaces and appraise them regarding shop-floor problems. To provide practical experience in solving open ended problems in real work setting so as to cause transfer of college based knowledge and skills to solve practical problems and thereby develop confidence in the students in the analysis, synthesis and evaluation of practical problems leading to creative thinking.

- At the end of the VI semester each student would undergo Industrial Training in an industry/ Professional organization / Research Laboratory with the prior approval of the Head of Department and Training & Placement Officer,
- Students shall be required to submit a **written typed report** along with a certificate from the organization and present a PPT based on the training.
- Students shall be required to give the presentations in the allotted period about the training attended after 5th Semester.
- The presentation and report of the Training shall be evaluated during this period (=2 hrs per week) by Board of Examiners to be appointed by the Faculty Coordinator-Training Seminar who will award the grades.

CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	1	1	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	1	1	1	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

CO- PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	**2**	–
CO2	–	**2**	–
CO3	–	**2**	–
CO4	–	**2**	–
CO5	–	**2**	–

Note: On the basis of mapping of COs with POs, this course is related to Employability/Skill

SEVENTH SEMESTER

CODE: BMECME7101 DESIGN OF MACHINE ELEMENT-II 3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the effect of stress concentration on beams

CO2 Inspect the load bearing capacity of curved beams

CO3 Analyze the selection of belts from the given application

CO4 Illustrate the terminologies of gears and selection of gears on the basis of force analysis

CO5 Analyze the selection of bearing from the given application

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Design for Fluctuating Loads	8
2.	Design of Machine Members	7
3.	Design of Drive Systems	6
4.	Design of Gears	8
5.	Design of Bearings	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Design for Fluctuating Loads**
	• Introduction of Unit • Stress concentration – causes & remedies, Fatigue Considerations in Design: S-N curve, Variable load, loading pattern, Endurance stresses, influence of size, surface finish, notch sensitivity and reversed stresses. Goodman line, Soderberg, Design of machine members subjected to combined, steady and alternating stresses • Conclusion of Unit including Real Life Application
2.	**Design of Machine Members**
	• Introduction of Unit • Pre loading of bolts; effect of initial tension & applied loads, Bolts subjected to variable stresses. Design ofmembers which are curved like crane hook, body of C-clamp, machine frame etc. • Conclusion of Unit including Real Life Application
3.	**Design of Drive Systems**
	• Introduction of Unit • **Power Transmissions Systems, Pulleys**: Design of helical compression, tension Springs. Springs under variable stresses. Design of belt, rope and pulley drive system, selection of chain & sprocket drive systems. Transmission efficiencies & Materials. • Conclusion of Unit including Real Life Application
4.	**Design of Gears**
	• Introduction of Unit • **Gears:** Classification, Selection of gears, Terminology of gears, Design of gear teeth, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form or Lewis factor for gear tooth, Dynamic load on gear teeth –Barth equation and Buckingham equation and their comparison. Design of spur and helical. • Conclusion of Unit including Real Life Application
5.	**Design of Bearings**

	• Introduction of Bearing, uses and their types. • Design of pivot and collar bearing , Design of sliding & journal bearing; Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, types of lubrication – Boundary, mixed and hydrodynamic lubrication. Design of journal bearings using Raimondi and Boyd's Charts, Lubricants and their properties. • Conclusion of Unit including Real Life Application

C. RECOMMENDED STUDY MATERIAL

Sr. No.	Book	Author	Edition	Publication
Reference Books				
1.	Machine Design	Black P.H. and O. Eugene Adams	Latest	Tata McGraw Hill
2.	Fundamentals of MachineComponents Design	Juvinal R.C	Latest	John Wiely and Sons
3.	Mechanical Engineering Design	Shigley J.E. and Mischke C.R.	Latest	McGraw Hill Pub. Co. Ltd.
4.	Design of machine elements	Bhandari V.B	Latest	Tata McGraw Hill
5.	Machine Design	P. Kannaiah	Latest	Scitech Publication
6.	Design Data Hand Book	K. Lingaiah,	Latest	McGraw Hill,
Important Web Links				
1	https://nptel.ac.in/courses/112105125/			
2	https://nptel.ac.in/courses/112105124/			
3	https://nptel.ac.in/courses/112101005/			

D.**CO- PO Mapping**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	2	—	—
CO2	1	—	—
CO3	2	—	—
CO4	2	—	—
CO5	2	—	—

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME7102	REFRIGERATION AND AIR CONDITIONING	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Examine the basic principles of refrigeration and air conditioning.

CO2 Analyze air refrigeration systems and vapor compression refrigeration systems.

CO3 Analyze vapor absorption refrigeration systems and steam jet refrigeration systems.

CO4 Apply the concept in designing and selection of refrigeration and air conditioning equipment.

CO5 Analyze the psychometric properties of air and evaluate applications and design calculations of RSHF, ERSHF, GFSH.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Basics of Refrigeration	08
2.	Vapour Compression Refrigeration System	07
3.	Vapour Absorption Refrigeration System	07
4.	Air-conditioning systems	07
5.	Psychrometry and load Analysis	07

B. DETAILED SYLLABUS

Unit No.	Unit Details
1	**Basics of Refrigeration**
	• Introduction of Unit • **Refrigeration**: Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P. • **Air Refrigeration cycle**: Open and closed air refrigeration cycles, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Boot strap refrigeration, Regenerative, reversed Brayton cycle, Brayton cycle with regenerative H.E. • Conclusion of Unit including real life applications
2	**Vapour Compression Refrigeration System**
	• Introduction of Unit • **Vapour Compression System:** Single stage system, Analysis of vapour compression cycle, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheatingof refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, • **Refrigerants**: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. • Conclusion of Unit including real life applications
3	**Vapour Absorption Refrigeration System**
	• Introduction of Unit • **Vapour Absorption system:** Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, • Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. Electrolux Refrigerator • Conclusion of Unit including real life applications
4	**Air-conditioning systems**
	• Introduction of Unit • **Air-conditioning systems:** classification, system components, all air, all water, air water systems, room air conditioners, packaged air conditioning plant, central air-conditioning systems, split air conditioning systems.

	• **Air conditioning system components:** fans types, classification and selection, air cleaning devices classification, types, construction and working, humidifiers and dehumidifiers • Conclusion of Unit including real life applications
5	**Psychrometry and load Analysis**
	• Introduction of Unit • **Psychrometry**: Psychometric properties, psychometric relations, pyschrormetric charts, psychrometric processes, cooling coils, By-pass factor and air washers. • **Cooling load calculations**: Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling, selection of air conditioning. • Conclusion of Unit including real life applications

C. RECOMMENDED STUDY MATERIAL

Sr. No	Reference Book	Author	Edition	Publication
1	Refrigeration and Air Conditioning	CP Arora	Latest	TMH.
2	Refrigeration and Air Conditioning	. Sapali S.N.,	Latest	PHI Learning Private Ltd
3	Refrigeration and Air Conditioning	Manohar Prasad	Latest	New Age. International
4	Refrigeration and Air Conditioning	R.S. Khurmi& J.K Gupta	Latest	S.Chand
5	Refrigeration and Air-conditioning	Ramesh Arora ,	Latest	Prentice Hall of India,
6	A Course in Refrigeration and Air conditioning	SC Arora &Domkundwar	Latest	Dhanpatrai
7	Basic Refrigeration and Air- Conditioning	Ananthanarayanan	Latest	TMH
Important Web links				
1	https://nptel.ac.in/courses/112105128/			
2	https://beeindia.gov.in/			
3	https://www.ashrae.org/			

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	**3**	**2**	**1**	**1**	–	–	–	–	–	–	–	–
CO2	**3**	**3**	**1**	**1**	–	–	–	–	–	–	–	–
CO3	**3**	**2**	**2**	**1**	–	–	–	–	–	–	–	–
CO4	**3**	**2**	**2**	**1**	–	–	–	–	–	–	–	–
CO5	**2**	**2**	**1**	**1**	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME7103 OPERATIONS RESEARCH 3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student will be able to:

CO1 Analyze the linear programming models and able to optimize the modeled problem by graphical approach and simplex method.

CO2 Examine and formulate the transportation and assignment problem and optimize by advance methods.

CO3 Analyze the Queuing Theory and able to process n Jobs through 3 Machines, process of 2 Jobs through m machines, processn Jobs through m Machines.

CO4 Illustrate game theory to solve complex problem like Rectangular game, Saddle point, Solution of games with saddle points, Rectangular games without saddle points, Dominance principle on m x 2 & 2 x n games.

CO5 Apply the project management tools and utilize the concept of PERT and CPM to manage the complex project schedule.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Introduction and Linear programming problem	7
2	Transportation and Assignment problem	7
3	Queuing Theory and Sequencing problem	8
4	Theory of Games	7
5	PERT & CPM	7

B. DETAILED SYLLABUS

Unit No.	Unit Details
1.	**Introduction and Linear programming problem**
	• **Introduction of Unit** • Introduction to Operations Research, Historical development, Main characteristics, phases, scope andlimitations of Operations Research. • Linear Programming: Formulation of the problem, Graphical solution of LPP, Simplex method - slack, surplus and artificial variables. • **Conclusion and Summary of Unit**
2.	**Transportation and Assignment problem**
	• Introduction of Unit • Transportation problem formulation, unbalanced Transportation problem, Basic feasible solutions by Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: The stepping stone method and MODI method. • Assignment problem formulation, Hungarian method for optimal solution, unbalanced assignment problem. • Conclusion and Summary of Unit
3.	**Queuing Theory and Sequencing problem**
	• Introduction of Unit • Queueing Theory: Introduction of the queuing system, various components of a queueing system. Operating characteristics of a queuing system, Classification of Queuing models, simple queuing models, simple Numerical. • Sequencing models. Solution of Sequencing Problem, Processing of n Jobs through 2 Machines, Processing of n Jobs through 3 Machines, Processing of 2 Jobs through m machines, Processing n Jobs through m Machines. • Conclusion and Summary of Unit
4.	**Theory of Games**

	• Introduction of Unit • Games Theory: Introduction of Game theory, Rectangular game, Saddle point, Minimax (Maximin),

	Method of optimal strategies, Value of the game, Two person-Zero sum game, Solution of games with saddle points, Rectangular games without saddle points, Dominance principle on m x 2 & 2 x n games. • Conclusion and Summary of Unit
5.	**PERT & CPM**
	• Introduction of Unit • PERT and CPM: Introduction to PERT (Project Evaluation and review Technique) and CPM (Critical Path method), Basic steps and techniques, Network Diagram Representation, Forward and Backward Pass-computation, Representation in Tabular form. Critical path calculation by network analysis, Determination of floats, Construction of time chart and resource labeling. • Conclusion and Summary of Unit

C. RECOMMENDED STUDY MATERIAL

Sr. No	Reference Books	Author	Publication
1.	Introduction to Operations Research	Hillier F.S. and Lieberman G.J.	CBS Publishers.
2.	Operations Research	Taha H.A.	Pearson Education.
3.	Operations Research	Ravindran, Phillips and Solberg	Wiley India.
4.	Principles of Operations Research	Wagner H.M.	Prentice Hall of India
5.	Linear Programming and Network Flows	Bazaraa , Jarvis and Sherali	Wiley India.
6.	Operations Research	Gupta and Heera	S. Chand Publications
Important Web links			
1	https://nptel.ac.in/courses/112106134/		
2	http://www.orcomplete.com/		

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	1	2	–	–	–	–	–	–	–	–
CO2	2	3	1	1	–	–	–	–	–	–	–	–
CO3	2	3	2	1	–	–	–	–	–	–	–	–
CO4	2	3	1	2	–	–	–	–	–	–	–	–
CO5	2	3	2	1	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	–
CO2	–	2	–
CO3	–	2	–
CO4	–	2	–
CO5	–	2	–

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMEEME7111	TOTAL QUALITY MANAGEMENT	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Understand the basic concepts of quality.

CO2 Analyze the economics of quality and measurement of the cost of quality.

CO3 Illustrate the use control charts for statistical quality control.

CO4 Understand the effects of sampling plan parameters on sampling plan performance.

CO5 Discuss the emerging concepts of quality management in products and service sectors.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Basics of Quality	07
2.	Economics of quality and measurement of the cost of quality	07
3.	Process control	08
4.	Acceptance sampling	07
5.	Emerging concepts of quality management	07

B. DETAILED SYLLABUS

Unit No.	Unit Details
1	**Basics of Quality**
	• Introduction of Unit • **Quality:** Introduction, definitions and history of quality control, Quality function and concept of quality circle, Quality policy and objectives. • **Quality- The changing Business condition:** The Quality Function; Managing for Quality; Quality policy; Quality circle; Perspective on Quality—Internal versus External. • Conclusion of Unit including real life applications
2	**Economics of quality and measurement of the cost of quality**
	• Introduction of Unit • **Quality considerations in design:** Cost of poor Quality; Categories of Quality Cost; Analysis of Quality costs; Economic models of Quality of conformance; Quality measurement in design, Quality Planning & Quality Control; Quality Improvement; Theories of motivation; Create and maintain awareness of Quality**.** • Conclusion of Unit including real life applications
3	**Process control**
	• Introduction of Unit • **Process control:** Use of control charts and process engineering techniques for use of control charts and process engineering techniques for implementing the quality plan, Definition and Importance of statistical process control; Statistical Control charts; Steps in setting up a control chart; Control chart for variables data; Process Capability; Estimating Inherent or potential Capability from a Control –chart analysis; Measuring process performance; Attribute Control Charts. • Conclusion of Unit including real life applications
4	**Acceptance sampling**
	• Introduction of Unit • **Acceptance sampling of variables and statistical tolerance analysis:** The concept of Acceptance Sampling; Economies of Inspection; Sampling Risk: The Operating Characteristic curve; Analysis of some Rule-of–Thumb Sampling; Quality Indices for Acceptance Plan; Types of Sampling Plan; Single sampling, Double Sampling and Multiple Sampling; Characteristic of a good Sampling Plan; Dodge- Roming Sampling Tables; Acceptance Sampling by Variable**s** • Conclusion of Unit including real life applications
5	**Emerging concepts of quality management**

	• Introduction of Unit

	• **Taguchi's concept of off-line quality control:** Elements of TQM; Traditional versus modern quality management; Deming's philosophy; The Juran Philosophy; Strength and Weakness of Taguchi's ideas; Just In Time (JIT); benchmarking; Business Process Re-engineering (BPR); Supply Chain Management (SCM). Ishikawa's cause and effect diagram. • Conclusion of Unit including real life applications

C. RECOMMENDED STUDY MATERIAL

Sr. No	Reference Book	Author	Edition	Publication
1	Quality Planning and Analysis	JM Juran and Gryna	Latest	McGraw Hill Education
2	Quality Control and Applications	Hansen & Ghare	Latest	PHI Learning Pvt Ltd
3	Industrial Engineering Management	O. P. Khanna	Latest	Dhanpat Rai Publications
4	Total Quality Management – An Introductory Text	Paul James	Latest	Prentice Hall
Important Web links				
1	https://archive.nptel.ac.in/courses/110/104/110104080/			

D. CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	–	2	2	–	–	–	–	–	–	3	–
CO2	2	–	2	2	–	–	–	–	–	–	3	–
CO3	2	–	2	2	–	–	–	–	–	–	3	–
CO4	2	–	2	2	–	–	–	–	–	–	3	–
CO5	2	–	2	2	–	–	–	–	–	–	3	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	3	–	–
CO2	3	–	–
CO3	3	–	–
CO4	3	–	–
CO5	3	–	–

Note: On the basis of mapping of COs with POs, this course is related to Enterneurship.

Code: BMEEME7104	FINITE ELEMENT ANALYSIS	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Analyze the finite element method and its applications.

CO2 Analyze problems using numerical methods in finite element method.

CO3 Analyze and solve the problem of one-dimensional finite element analysis.

CO4 Analyze and solve problem of two-dimensional finite element analysis.

CO5 Analyze the finite element formulation of field problems and finite element formulation of solid mechanics problems.

A. OUTLINE OF THE COURSE

UnitNo.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Finite Element Method	7
2.	Numerical Methods in FEM	8
3.	One-dimensional Finite Element Analysis	7
4.	Two dimensional Finite Element Analysis	7
5.	Finite Element Formulation	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Finite Element Method**
	• Introduction of Unit • **Introduction:** Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Elements of variational calculus. • Conclusion of Unit including real life applications.
2.	**Numerical Methods in FEM**
	• Introduction of Unit • **Types of Elements Used :**Interpolation Polynomials - Linear elements Shape function - Analysis of simply supported beam - Element and Global matrices - Two-dimensional elements, triangular and rectangular elements • **Numerical Methods in FEM:** Evaluation of shape functions - One dimensional & triangular elements, Quadrilateral elements. • Conclusion of Unit including real life applications.
3.	**One-dimensional Finite Element Analysis**
	• Introduction of Unit • **One-dimensional Finite Element Analysis**: Basics of structural mechanics : stress and strain tensor, constitutive relation. Principle of minimum Potential. General steps of FEM, Generalized coordinate approach, derivation of element equation - Assembly of element equation Imposition of boundary conditions - Solution of equation - Cholesky method. • Conclusion of Unit including real life applications.
4	**Two dimensional Finite Element Analysis**
	• Introduction of Unit • **Two dimensional Finite Element Analysis:** Finite element formulation using three nodded triangular (CST) element and four nodded rectangular element, Plane stress and Plain strain problems. Shape functions, node numbering and connectivity. • Conclusion of Unit including real life applications
5	**Finite Element Formulation**

	• Introduction of Unit • **Finite Element Formulation of Field Problems:**1-D and 2-D heat transfer, fluid flow (incompressible and non viscous fluid) in ducts, Simple electrical and magnetic field problems. • **Finite Element Formulation of Solid Mechanics Problems:** 1-D problem of shaft. • Conclusion of Unit including real life applications

RECOMMENDED STUDY MATERIAL:

S.No	Book	Author	Edition	Publication
Reference Books				
1.	Numerical Methods	E Balagurusamy	Latest	Tata McGraw Hill
2.	Introduction to Finite Elements in Engineering	T.R Chandragupta and A.D. Belegundu	Latest	Prentice Hall India
3.	Finite Element Analysis	C.S. Krishnamoorthy	Latest	Tata McGraw Hill
4.	Finite Element Procedure in Engineering Analysis	K.J. Bathe	Latest	Tata McGraw Hill
5.	An Introduction to Finite Element Method	J. N. Reddy	Latest	Tata McGraw Hill
6.	Concepts and Application of FiniteElement Analysis	R.D. Cook, D.S. Malcus and M.E. Plesha	Latest	John Wiley
Important web Links				
	https://nptel.ac.in/courses/112106135/			
	https://nptel.ac.in/courses/112104193/			
	https://nptel.ac.in/courses/112104205/			

CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	2	–	–
CO2	1	–	–
CO3	2	–	–
CO4	2	–	–
CO5	2	–	–

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill

Code: BMEEME7112	UNCONVENTIONAL MACHINING PROCESSES	3 Credits [LTP: 3-0-0]

OVERVIEW AND OBJECTIVES: The objective of Unconventional Machining is to lead the students to completely understandthe unconventional machining processes. Therefore, the course starting from the classification of unconventional machining processes based on the elementary mechanism and the machinability of materials with different unconventional processes, presents for each process the basic principles, the most relevant industrial solutions, and the main applications.

Course Outcome

The Student will be able to:

CO1 Illustrate the methods of various Non-Traditional Machining.

CO2 Examine the use of mechanical energy of Non Traditional Machining.

CO3 Analyze the use of electrical energy of Non Traditional Machining.

CO4 Examine the use of thermal energy of Non Traditional Machining.

CO5 Illustrate the Chemical and Hybrid Machining Processes.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	**Non Traditional Machining Methods**	07
2.	**Mechanical Energy Techniques**	08
3.	**Electrical Energy Techniques**	07
4.	**Thermal and Thermo Electrical Energy Techniques**	07
5.	**Chemical and Hybrid Machining Techniques**	07

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Non Traditional Machining Methods**
	• Introduction of Unit • **Introduction:** Introduction to non traditional machining methods, Need for non - traditional machining, Sources of metal removal, Classification on the basis of energy sources, Parameters influencing selection of process. Limitations of conventional manufacturing processes, future possibilities. • Conclusion of Unit including Real Life Application
2.	**Mechanical Energy Techniques**
	• Introduction of Unit • **Abrasive Jet Machining (AJM):** Operating principles, Equipment, Parameters influencing metal removal, Applications, Advantages and Limitations. • **Water Jet Machining (WJM):** Operating principles, Equipment, Parameters influencing metal removal, Applications, Advantages and limitations. • **Ultra Sonic Machining (USM):** Operating principles, Equipment and sub systems, Parameters influencing metal removal, Applications, Advantages and limitations. • Conclusion of Unit including Real Life Application
3.	**Electrical Energy Techniques**
	• Introduction of Unit • **Electro Chemical Machining (ECM):** Operating principles, Equipment and sub systems, Parameters influencing metal removal, Applications, Advantages and limitations, Current developments in ECM. • **Electro Chemical Grinding (ECG):** Operating principles, Equipment and sub systems, Parameters influencing metal removal, Applications, Advantages and limitations • Conclusion of Unit including Real Life Application
4.	**Thermal and Thermo Electrical Energy Techniques**

	• Introduction of Unit • **Thermal Energy Techniques** Operating principles, Equipment and sub systems, Parameters influencing metal removal, Applications, Advantages and limitations of Electron Beam Machining (EBM), Plasma Arc Machining (PAM) and Laser Beam Machining (LBM). • **Thermo Electrical Energy Techniques** Electrical Discharge Machining (EDM) and Wire Cut Electrical Discharge Machining (WCEDM): Operating principles, Equipment and sub systems, Parameters influencing metal removal, Applications, Advantages and limitations. Electrical Discharge Grinding (EDG): Operating principles, Equipment and sub systems, Parameters influencing metal removal, Applications, Advantages and limitations. • Conclusion of Unit including Real Life Application
5.	**Chemical and Hybrid Machining Techniques**
	• Introduction of Unit • **Chemical Machining:** Elements of the process: Resists (maskants), Etchants. Types of chemical machining process-chemical blanking process, chemical milling process. Process characteristics of CHM: material removal rate, accuracy, surface finish, advantages, limitations and applications of chemical machining process. • **Hybrid Machining Processes:** Concept, classification, process capabilities, and applications of various hybrid machining methods based on USM, EDM, ECM, etc. • Conclusion of Unit including Real Life Application

C. RECOMMENDED STUDY MATERIAL

Sr.No	Book	Author	Edition	Publication
a.	**Reference Books**			
1.	Non-Conventional Machining	Mishra, P. K	Latest	The Institution of Engineers (India), New Delhi
2.	Unconventional Machining Process	Garry F. Benedict	Latest	Marcel Dekker Publication, New York
3.	Non Tradtional Machining Techniques	Bennedict, G. F.	Latest	Marcel Decker, New York
4.	Advanced Machining Processes	Jain Vijay K.	Latest	Allied
5.	A Text book of Production Engineering	Sharma, P. C	Latest	Text Book Series
6.	Modern Manufacturing Process	Pandey and Sha	Latest	Prentice Hall, New Jersey.
b.	**Websites**			
	• www.nptel.com • www.newagepublishers.com/samplechapter/001566.pdf • www.nprcet.org/.../10122MEE17%20-%20Unconventional%20Manufac..			

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	2	2	2	2	–	–	–	–	–	–	–	–

E.CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME7201	COMPUTER AIDED DESIGN LAB-I	1 Credit [L T P: 0-0-2]

COURSE OUTCOMES

The student will be able to:

CO1 Understand the different coordinate system.

CO2 Create basic mechanical components in 3-D Modeling.

CO3 Apply the basic entities in 2D Drafting.

CO4 Apply different surface modeling editing commands.

CO5 Apply the shading and rendering techniques.

LIST OF EXPERIMENTS

1	Learn the basic initial setting and viewing of the 3D Modeling software's interface.
2	Understand different coordinate system and do a exercise.
3	Learn 3-D Modeling and draw basic mechanical components.
4	Learn and use of 3-D Advanced Modeling.
5	Feature Modification and Manipulation in 3D Modeling.
6	Learn and draw the basic entities in 2D Drafting with an example of machine element.
7	Learn and use of Detailing & Annotation.
8	Draw the different Surface model with different editing commands.
9	Learn and use of Sheet Metal with different editing commands.
10	Learn and use shading and rendering techniques for better visual appearance.
11	Use and learn import/export techniques and customization of drafting software.

CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	–	2	–	–	–	–	–	–	–
CO2	3	3	2	–	3	–	–	–	–	–	–	–
CO3	2	2	2	–	3	–	–	–	–	–	–	–
CO4	3	2	2	–	3	–	–	–	–	–	–	–
CO5	2	2	2	–	2	–	–	–	–	–	–	–

CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	–
CO2	–	2	–
CO3	–	3	–
CO4	–	2	–
CO5	–	2	–

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME7202	REFRIGERATION AND AIR CONDITIONING LAB	1 Credit [LTP : 0-0-2]

Course Outcomes

The student will be able to:

CO1 Illustrate the the fundamental principles and different methods of refrigeration and air conditioning.

CO2 Analyze refrigeration cycles and evaluate performance using refrigerant property tables.

CO3 Differentiate refrigerants with respect to properties, applications and environmental issues.

CO4 Illustrate air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.

CO5 Examine equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems.

A. LIST OF EXPERIMENTS:

1.	Study of various elements of a mechanical refrigerator system through cut sections models / actual apparatus.
2.	Study and performance of domestic refrigerator,
3.	Study of an Ice plant and visit to a cold storage for study.
4.	Calculation/ Estimation of cooling load for large building.
5.	Study and trial on cooling towers.
6.	Study of measuring instruments and various tools used in refrigeration and air-conditioning systems.
7.	Study of thermostat and humidistat, dryer, oil separator.
8	Study of construction of hermetically sealed compressor and actual viewing of a cut model of the same (reciprocating, rotary and car A/C compressor).
9.	Experiment on desert coolers.
10.	To study basic components of air-conditioning system.
11.	Experiment on air conditioning test rig and calculation of various performance
12.	Study and performance of window type room air conditioner.
13.	Visit to a central Air conditioning plant for study of processes for winter and summer air conditioning.

Virtual Lab
1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/refigeration/index.php
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/refigeration/labs/exp1/index.php

CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	2	2	2	2	–	–	–	–	–	–	–	–
CO3	2	2	2	2	–	–	–	–	–	–	–	–
CO4	3	3	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	3
CO2	–	–	3
CO3	–	–	3
CO4	–	–	3
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill development

Code: BMECME7203 ADDITIVE MANUFACTURING AND PROTOTYPING 3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will able to:

CO1 Analyze the fundamentals of Additive Manufacturing Technologies for engineering applications.

CO2 Recommend the methodology to manufacture the products using SLA and SGC technologies and study their applications, advantages and case studies.

CO3 Apply the methodology to manufacture the products using LOM and FDM technologies and study their applications, advantages and case studies.

CO4 Illustrate the methodology to manufacture the products using SLS and 3D Printing technologies and study their applications, advantages and case studies.

CO5 Apply the Preparation of making of 3D Printer Model.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Additive Manufacturing Technology	07
2.	Liquid based systems	08
3.	Solid based systems	07
4.	Powder Based Systems	07
5.	Three dimensional printing (3DP)	07

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Additive Manufacturing Technology**
	• Introduction of Unit • Introduction, Prototyping fundamentals, Historical development, Advantages of AMT, Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of AMT process, Applications to various fields • Conclusion of Unit including Real Life Application
2.	**Liquid based systems**
	• Introduction of Unit • Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid ground curing (SGC): Models and specifications, process, working, principle, applications, advantages and disadvantages, case studies. • Conclusion of Unit including Real Life Application
3.	**Solid based systems**
	• Introduction of Unit • Laminated object manufacturing (LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages. • Conclusion of Unit including Real Life Application
4.	**Powder Based Systems**
	• Introduction of Unit • Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, case studies: • Conclusion of Unit including Real Life Application
5.	**Three dimensional printing (3DP)**
	• Introduction of Unit • Models and specification, process, working principle, applications, advantages and disadvantages, case studies. • Conclusion of Unit including Real Life Application

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	3	2	1	—	—	—	—	—	—	—
CO2	2	2	2	2	1	—	—	—	—	—	—	—
CO3	2	2	2	2	2	—	—	—	—	—	—	—
CO4	3	3	2	2	3	—	—	—	—	—	—	—
CO5	3	2	2	2	3	—	—	—	—	—	—	—

CO-PSO Mapping

	PSO 1	PSO 2	PSO 3
CO1	—	—	—
CO2	—	—	—
CO3	—	—	—
CO4	—	—	—
CO5	—	—	—

Code: BMECME7204	Computational Mechanics Lab	1 Credit [L T P: 0-0-2]

Course outcomes

C01 Develop extensive knowledge and understanding of a wide range of computer computational software.
CO2 Do the plots and export this for use in reports and presentations.
CO3 Understanding of internal and external flow simulations.
CO4 Creating skills to solve biomedical real life problem.
CO5 Simulation of structural problem such as beam.

LIST OF EXPERIMENTS:

1.	Use of software and its application to Mechanical Engineering problems.
2.	Study of Software Tools and Interface
3.	Post processing software for result analysis and graph plotting
3.	Laminar flow simulation through duct
4.	Turbulent flow through duct
5.	Simulation of external flow over cylinder and sphere
6.	Simulation of conduction-diffusion problem
7.	Simulation of subsonic flow (internal and external)
8.	Simulation of supersonic flow (internal and external)
9.	Simulation of real-life problem such as flow through human airways, arteries
10.	Beam Analysis by using Software.

CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	2	–	–	–	–	–	–	–
CO2	2	2	2	2	2	–	–	–	–	–	–	–
CO3	3	2	2	2	2	–	–	–	–	–	–	–
CO4	3	2	2	2	3	–	–	–	–	–	–	–
CO5	2	2	2	2	2	–	–	–	–	–	–	–

CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	–
CO2	–	2	–
CO3	–	2	–
CO4	–	3	–
CO5	–	2	–

Note: On the basis of mapping of COs with POs, this course is related to entrepreneurship

Code: BMECME7301 **Minor Project** **2 Credits [LTP : 0-0-4]**

Course Outcomes

CO1 Demonstrate a depth of knowledge of Mechanical Engineering.

CO2 Complete an independent research project, resulting in at least a thesis publication, and research outputs in terms of publications in high factor journals, conference proceedings, and patents.

CO3 Demonstrate knowledge of contemporary issues in their chosen field of research.

CO4 Demonstrate an ability to present and defend their research work to a panel of experts.

CO5 Analyze the methodologies of work taken and apply it the model preparing.

CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	–	–	–	–	2	–	2	3	2	–	3
CO2	2	–	–	–	–	2	–	2	3	2	–	3
CO3	2	–	–	–	–	2	–	2	3	2	–	3
CO4	2	–	–	–	–	2	–	2	3	2	–	3
CO5	2	–	–	–	–	2	–	2	3	2	–	3

CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	3
CO2	–	2	3
CO3	–	2	3
CO4	–	2	3
CO5	–	2	3

Note: On the basis of mapping of COs with POs, this course is related to entrepreneurship

Code: BMECBX7113 Principle of Finance 3 Credit [LTP:

Course Outcomes:

On successful completion of the course the learner will be able to

CO	Cognitive Abilities	Course Outcomes
CO – 01	ANALYZE	ANALYZE the basic concepts in finance and implication of finance on business
CO – 02	EVALUATING	Evaluate various types of internal sources of finance & their importance, applications for a business organization.
CO – 03	Apply	Apply various types of external sources of finance & their importance, applications for a business organization
CO - 04	Analyzing	ANALYZE the constituents of capital structure, factors affecting capital structure & implications of constituents on business organization.
CO – 05	Analyzing	ANALYZE recent trends in business finance & current issues related to them.

Syllabus:

1. Basic concepts in finance:

Definition - Nature and scope of finance function, Financial Management - Meaning – Approaches: - Traditional, Modern and Role of finance manager in traditional & modern era.

2. Sources of Finance -I:

Internal: - Reserves and surplus, Bonus shares & Retained earnings- meaning, types, advantages and limitations of these sources.

3. Sources of Finance -II:

External: - Shares, Debentures, Public Deposits, borrowing from banks: - meaning, types, advantages and limitations of these sources

4. Capital Structure:

Meaning criteria for determining capital structure, Factors affecting capital structure, Capitalization: - Meaning, Over capitalization and Under Capitalization - meaning, causes, consequences and remedies.

5. Recent Trends in business finance:

Meaning and nature of Venture Capital, Leasing, Microfinance and Mutual Fund.

- **Teaching Pedagogy**:

Unit	Tools	Expected Outcome
Unit 1	➢ Power Point Presentation	➢ Understand the concept of Financial Management. ➢ Students will be acquainted with basic finance functions & role of finance manager.
Unit 2	➢ Power Point Presentation	➢ Students will develop rational understanding regarding role and utility of different sources of internal finance ➢ Understand the comparative analysis of various sources of internal finance.
Unit 3	➢ Power Point Presentation	➢ Students will understand the comparative analysis of various sources of external finance. ➢ Understand the Financial institutions who provide sources of finance
Unit 4	➢ Power Point Presentation ➢ Case Studies	➢ Analyse the rational of sound capital structure of a business organization.

		➢ Students will be able to prepare report on assessment of capital needs of a business organization. ➢ Understand the implications of over or under capitalization of business organization.
Unit 5	➢ Power Point Presentation ➢ Case Studies	➢ Understand the concept & issues of Venture Capital, Leasing, Microfinance, Mutual Fund ➢ Analyze their role/ contributions to the business organizations & economy.

- **Recommended Study Material**

S. No	Title of the Book	Authors	Publication
01	Financial management – Theory and Practice	Prasanna Chandra	McGraw Hill Education
02	Financial Management	I.M. Pandey	Vikas Publishing House Pvt. Ltd.
03	Financial Management	Rajiv Srivastava &Anil Misra	Oxford – University Press
04	Financial Management	P.V. Kulkarni &B.G.Satyaprasad	Himalaya Publishing House
05	Fundamentals of Financial management	James C. Van Horne , John M. &Wachowicz , JR	Prentice Hall of India Pvt. Ltd.
06	Financial management Comprehensive Text Book with Case Studies	Ravi M. Kishore	Taxmann's
07	Financial management – recent Trends In Practical Application	Chandra Hariharan Iyer	International Book House Pvt.Ltd
08	Basic Financial Management	M .Y Khan & P.K Jain	Mc Graw Hill Education

EIGHT SEMESTER

Code: BMECME8101	ERGONOMICS AND WORKPLACE DESIGN	3 Credits [LTP: 3-0-0]

COURSE OUTCOMES

The student will be able to:

CO1 Identify the need of ergonomics and ergonomics methods. CO2

Analyze anthropometry details regarding ergonomic design.

CO3 Apply the anthropometry details in designing of work areas, tools and equipment.CO4

Analyze the human safety and ergonomics at workstations.

CO5 Justify the simulation and simulation techniques.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction to Ergonomics	7
2.	The Human System	8
3.	Design of Work Areas, Tools, and Equipment	7
4.	Health and safety at work	7
5.	Simulation in Ergonomic Design	7

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to Ergonomics**
	• Introduction of Unit • Introduction to Ergonomics, Definition and History of Ergonomics. The evolution of Ergonomics, reasons to use ergonomics, micro- and macro- ergonomics, performing ergonomics, judging the effectiveness of ergonomics intervention. Trends in Industry That Impact Ergonomic Design. Ergonomic Methods- Field Studies, Experimental Simulation, Laboratory Experiment, Computer Simulation, Differences in Ergonomic Methods. • Conclusion and Summary of Unit
2.	**The Human System**
	• Introduction of Unit • The Skeletal Subsystem- The Extremities, Joint-Related Disorders. Muscle Contractions and Capabilities, The Role of Oxygen in Muscle Actions, Muscle Injuries and Disorders, Effects of Gender and Muscular Strength. Anthropometry- Predicting the Stature of People, Estimating Body Dimensions, Predicting the Segment Mass of the Human Body. • The Sensory Subsystems- The Visual Sensory Subsystem, Human Perception of Sound, Position and Motion Sensing. • Conclusion of Unit including real life applications.
3.	**Design of Work Areas, Tools, and Equipment**
	• Introduction of Unit • Applied Anthropometry- Drafting Templates, Computer Modeling Methods. Design of Work Areas and Stations- Traffic Areas, Workplace Dimensions and Layout Principles, Design of Seating. • Design of Tools and Equipment - Hands and Handedness: Some Initial Design Principles, Other DesiredProperties of Grip Design, Other Features of Hand Tool Design. Protective Equipment for the Operator- Safety Shoes, Helmets, Protective Gloves, Eye Protection and Spectacles, Hearing Protection. • Conclusion of Unit including real life applications.
4.	**Health and safety at work**
	• Introduction of Unit • Anthropometry of the hand, Fundamentals of handle design. Human factors in industrial safety: an overview. Ergonomic injuries, Back injury at work, Work-related upper limb disorders, Lifting and handling. • Human Diversity- Sex differences, Ethnic differences, Growth and development, Ageing. • Ergonomics in the Home- The kitchen, The bathroom, The bedroom. • Conclusion of Unit including real life applications.

5.	Simulation in Ergonomic Design
	• Introduction of Unit

	• Simulation Versus Other Methods in Ergonomics. Essential Elements of Computer Simulation- Higher-Level Computer Languages, Computer Simulation in Ergonomics. Cognitive Simulation- Production System Modeling of Cognitive Tasks, Temporal Simulation Using the Production System Model. Operator-in-the-Loop Simulation- Training Simulators, Ground Vehicle Simulators. Anthropometric Data- Children and youths. • Conclusion of Unit including real life applications.

C. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
1.	Human Factors and Ergonomics for Engineers	Mark R. Letho	Latest	Lawrence Erlbaum Associates
2.	A Guide to Ergonomics of Manufacturing	Martin Helander	Latest	TMH
3.	Introduction to Ergonomics	Bridger, R.S.	Latest	McGraw Hill,
4.	Human Factors for Information usability	Shackel, B.Richardson S	Latest	Cambridge University Press
5.	Bodyspace Anthropometry, Ergonomics and the Design of Work	STEPHEN PHEASANT	Latest	Taylor and Francis
Important web links				
	https://nptel.ac.in/courses/107103085/			
	https://nptel.ac.in/courses/107103004/			

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	2	2	2	2	–	–	–	–	–	–	–	–

A. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	2
CO2	–	–	3
CO3	–	–	3
CO4	–	–	2
CO5	–	–	2

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME8102	COMPUTER INTEGRATED MANUFACTURING	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student will be able to:

CO1 Analyze the role of CAM in manufacturing and its components.

CO2 Analyze the various part programming languages of conventional NC and CNC.

CO3 Illustrate the computer aided process planning in manufacturing firm with group technology.

CO4 Examine the role and importance of production management system via computers in manufacturing.CO5

Analyze manufacturing systems like FMS and Collaborative Engineering.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	**Computer Aided Manufacturing**	**07**
2.	**Part programming**	**07**
3.	**Computer Aided Process Planning**	**08**
4.	**Computer Aided Production Management Systems**	**07**
5.	**Computer Integrated Manufacturing Systems**	**07**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Computer Aided Manufacturing**
	• Introduction of Unit • **Introduction:** Overview of manufacturing processes, types of manufacturing systems, the product cycle, computer's role in manufacturing, sources and types of data used in manufacturing. • **The Beginning of CAM:** Historical Background, Basic components of NC systems, NC Procedure, NC coordinate system and machine motions, applications and economics of NC. • Conclusion of Unit including real life applications
2.	**Part programming**
	• Introduction of Unit • **Part programming-** manual and computer assisted such as APT Language. Computer Controls In NC Systems: Problems with conventional NC computer numerical control, Direct numerical control, combined CNC/ DNC systems, adaptive control machining system computer process interfacing, • Conclusion of Unit including real life applications
3.	**Computer Aided Process Planning**
	• Computer Aided Process Planning: Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data system, computer generated time standards. • Group Technology: Introduction, part families, part classification and coding, coding system and machining cells. • Conclusion of Unit including real life applications
4.	**Computer Aided Production Management Systems**
	• Introduction of Unit • **Computer Aided Production Management Systems:** Introduction to computer aided PPC, Introduction to computer aided inventory management, manufacturing resource planning (MRPII), computer process monitoring and shop floor control, computer process control. Computer Aided Quality Control. • Non-contact inspection methods, optical and non optical computer aided testing, Computer Aided Material Handling: Computer control on material handling, conveying, picking. • Conclusion of Unit including real life applications
5.	**Computer Integrated Manufacturing Systems**
	• Introduction of Unit • **Computer Integrated Manufacturing Systems:** Introduction, types special manufacturing systems, flexible manufacturing systems (FMS). • **Collaborative Engineering:** Introduction, Faster Design throughput, Web based design, changing design approaches, extended enterprises, concurrent engineering, Agile and lean manufacturing.

	• Conclusion of Unit including real life applications

C. RECOMMENDED STUDY MATERIAL

Sr. No.	Book	Author	Edition	Publication
Reference Books				
1.	Automation, Production System and CIM	Groover, M.P.,	Latest	Prentice-Hall of India
2.	Computer Integrated Design and Manufacturing	David Bedworth	Latest	TMH, New Delhi
3.	Computer Integrated Manufacturing Systems	YoremKoren,	Latest	McGraw Hill,
4.	Computer Integrated Manufacturing	Ranky, Paul G	Latest	Prentice Hall International
5.	Design rules for a CIM system	R.W. Yeomamas	Latest	North Holland Amsterdam

Important Web links

- https://nptel.ac.in/courses/112104289/
- https://www.sciencedirect.com/book/9780408007337/computer-integrated-manufacturing

D.CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	2	—	—	—	—	—	—	—
CO2	2	2	2	2	3	—	—	—	—	—	—	—
CO3	2	2	2	2	2	—	—	—	—	—	—	—
CO4	3	2	2	2	2	—	—	—	—	—	—	—
CO5	2	2	2	2	2	—	—	—	—	—	—	—

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	—	2	–
CO2	—	3	–
CO3	—	2	–
CO4	—	2	–
CO5	—	2	–

Note: On the basis of mapping of COs with POs, this course is related to Employability

Code: BMEEME8111 INDUSTRIAL INTERNET OF THINGS 3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student will be able to:

CO1 Analyze the real life IoT applications using off the shelf hardware and software.

CO2 Illustrate the Sensor and Interfacing functioning systems.

CO3 Recommend the protocol and cloud services and its business models: Saas, Paas, Iaas.

CO4 Illustrate the importance of Vulnerabilities of IoT, Privacy, Security requirements.

CO5 Analyze the Role of Analytics in IOT and real-life applications of Internet of Things.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Introduction to IOT and Architectures	**11**
2	Sensor and Interfacing	**6**
3	Protocols and Cloud	**6**
4	Privacy, Security and Governance	**6**
5	IOT Analytics and Applications	**7**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction to IOT and Architectures**
	• Introduction of Unit • Introduction to IOT, What is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, People &Process, Hype cycle, IOT Market, Trends& future Real life examples; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIOT. • Overview of IOT components; Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, • Conclusion of Unit
2.	**Sensor and Interfacing**
	• Introduction of Unit • Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet , Current, M2M etc • Conclusion of Unit
3.	**Protocols and Cloud**
	• Introduction of Unit • Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, Bacnet, BLE, Modbus, SPI , I2C, IIOT protocols –COAP, MQTT,6lowpan, lwm2m, AMPQ IIOT cloud platforms : Overview of cots cloudplatforms, predix, thing works, azure etc. Data analytics, cloud services, Business models: Saas, Paas, Iaas. • Conclusion of Unit
4.	**Privacy, Security and Governance**
	• Introduction to Unit • Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT, Network security techniques Management aspects of cyber security • Conclusion of Unit
5.	**IOT Analytics and Applications**

	• Introduction to Unit • IOT Analytics: Role of Analytics in IOT, Data visualization Techniques, Introduction to R Programming, Statistical Methods. Internet of Things Applications : Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Plant Automation, Real life examples of IIOT in Manufacturing Sector • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL

Sr.No	Reference Book	Author	Edition	Publication
1	Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications	Daniel Minoli	Latest	Willy Publications
2	Architecting the Internet of Things	Michahelles	Latest	Springer
3	Hands-On Industrial Internet of Things	Giacomo Veneri Antonio Capasso	Latest	Ingram short title
4	Industry 4.0: The Industrial Internet of Things	Alasdair Gilchrist	Latest	Apress
5	Industrial Internet of Things and Cyber-Physical Systems: Transforming the Conventional to Digital	Pardeep Kumar , VasakiPonnusamy	Latest	Business Science Reference
Important Web Links				
1	https://nptel.ac.in/courses/106105195/			
2	https://www.classcentral.com/			

CO – PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	–	–	2	–	–	–	–	–	2	–	2
CO2	3	–	–	2	–	–	–	–	–	2	–	2
CO3	3	–	–	2	–	–	–	–	–	2	–	2
CO4	3	–	–	2	–	–	–	–	–	2	–	2
CO5	3	–	–	2	–	–	–	–	–	2	–	2

CO – PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	–
CO2	–	3	–
CO3	–	2	–
CO4	–	2	–
CO5	–	2	–

Note: On the basis of mapping of COs with POs, this course is related to Employability

Code: BMEEME8112	SIX SIGMA AND LEAN MANUFACTURING	3 Credits [LTP: 3-0-0]

COURSE OUTCOME

The student will be able to:

CO1 Understand lean assessment and Six Sigma SIPCO,QFD.

CO2 Apply the various Tools and Techniques of six sigma.

CO3 Carry out Failure Mode Effect Analysis (FMEA).

CO4 Apply the Regression analysis, Hypothesis testing, ANOVA, Multivariate analysis.

CO5 Apply the Evaluation and Continuous Improvement Methods for six sigma.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time Required for the Unit (Hours)
1	Introduction to Six Sigma	07
2	Scope of Tools and Techniques	07
3	Six Sigma Methodologies	08
4	Six sigma process	07
5	Evaluation and Continuous Improvement Methods	07

B. DETAILED SYLLABUS

Unit	Contents
1.	**Introduction to Six Sigma**
	• Introduction of Unit • Lean metrics identify lean metrics; kaizen cloud identification in VSM ; lean assessment. improving targets and benchmarks; Six Sigma SIPCO,QFD; voice of the customer, kano models, cost of poor quality (COPQ) • Conclusion of Unit
2.	**Scope of Tools and Techniques**
	• Introduction of Unit • Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter -Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control -Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management. • Conclusion of Unit
3.	**Six Sigma Methodologies**
	• Introduction of Unit • Design For Six Sigma (DFSS),Design For Six Sigma Method – Failure Mode Effect Analysis (FMEA), FMEA process – Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder. • Conclusion of Unit
4.	**Six sigma process**

	• Introduction of Unit • Six sigma process – Measure phase, Six sigma tools (CTQ tree, Process capability calculation, Measurement system analysis using gauge R&R) – Measure phase, Six sigma process – analyze phase, Six sigma tools (Histogram, box plot, control chart, scatter chart, fish bone diagram, pareto analysis chart, interrelations diagram) – analyze phase, Six sigma special tools (Regression analysis, Hypothesis testing, ANOVA, Multivariate analysis), Affinity diagram, DOE. • Conclusion of Unit
5.	**Evaluation and Continuous Improvement Methods**
	• Introduction of Unit • Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S. • Conclusion of Unit

C. RECOMMENDED STUDY MATERIAL

Sr. No	Reference Book	Author	Edition	Publication
1	The Six Sigma Handbook	Thomas Pyzdek and Paul A. Keller	2020	McGraw Hill
2	Six Sigma Quality Improvement with MINITAB	Henderson, G. R.	Latest	Wiley
3	The certified six sigma Green Belt Handbook	Roderick A. Munro and Govindarajan Ramu and Daniel J. Zrymiak	2017	ASQ Quality Press and Infotech Standards India Pvt. Ltd
4	The Certified Six Sigma Black Belt Handbook	T. M. Kubiak and Donald W. Benbow	Latest	Pearson Publication
Important Web links:				
1	https://onlinecourses.nptel.ac.in/noc20_mg19/preview			

CO – PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	–	–	2	–	–	–	–	–	2	–	–
CO2	2	–	–	2	2	–	–	–	–	2	–	–
CO3	2	–	–	2	2	–	–	–	–	2	–	–
CO4	2	–	–	3	2	–	–	–	–	2	–	–
CO5	2	–	–	3	2	–	–	–	–	2	–	–

CO – PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	–
CO2	–	–	–
CO3	–	–	–
CO4	–	–	–
CO5	–	–	–

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMEEME8113 RELIABILITY AND MAINTENANCE ENGINEERING 3 Credits [LTP: 3-0-0]

OVERVIEW AND OBJECTIVES: The course provides knowledge on the maintenance policies and techniques as corrective maintenance, preventive maintenance, breakdown maintenance, predictive maintenance, condition based maintenance and reliability maintenance so that the student is able to manage independently a maintenance department in the industry.

The student will be able to:

CO1 Apply the fundamental principles of mechanical engineering.

CO2 Analyze the the latest changes in mechanical technological world.

CO3 Develop the capability to communicate efficiently among industry people.

CO4 Identify, formulate and model problems and find engineering solution based on a systems approach.

CO5 Awareness of the social, cultural, global and environmental responsibility as an engineer.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	**Reliability**	**7**
2.	**Types and Improvements**	**8**
3.	**Testing and Management**	**9**
4.	**Introduction to Maintenance**	**9**
5.	**Maintenance and Testing**	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Reliability**
	• **Introduction:** Definition of reliability, types of failures, definition and factors influencing system effectiveness, various parameters of system effectiveness. • **Reliability Mathematics:** Definition of probability, laws of probability, conditional probability, Bay's theorem; various distributions; data collection, recovery of data, data analysis Procedures, empirical reliability calculations. • Conclusion of Unit including Real Life Application
2.	**Types and Improvements**
	• Introduction of Unit • **Reliability:** Types of system- series, parallel, series parallel, stand by and complex; development of logic diagram, methods of reliability evaluation; cut set and tie set methods, matrix methods event trees and fault trees methods, reliability evaluation using probability distributions, Markov method, frequency and duration method. • **Reliability Improvements:** Methods of reliability improvement, component redundancy, system redundancy, types of redundancies-series, parallel, series - parallel, stand by and hybrid, effect of maintenance. • Conclusion of Unit including Real Life Application
3.	**Testing and Management**
	• Introduction of Unit • **Reliability Testing:** Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards. • **Spare Parts Management:** Spare parts, features and categorization of spares, cost considerations, Techniques of cost reduction; Selective controls used in spare parts control; ABC analysis, FSN, XYZ, VED and other approaches. Inventory control of spares. • Conclusion of Unit including Real Life Application
4.	**Introduction to Maintenance**

	• **Introduction:** Maintenance Objectives and Functions; Maintenance Organisation and Administration of Maintenance Systems. Need of planned maintenance. Maintenance policies; Breakdown, time based maintenance: Block replacement, age replacement and periodic replacement policy. • **Corrective and preventive maintenance.** Maintenance planning, Scheduled maintenance. Cost of maintenance versus Cost of equipment and production delays. Inspection: Inspection intervals, Inspection reports, card history system • Conclusion of Unit including Real Life Application
5.	**Maintenance and Testing**
	• Introduction of Unit • Predictive maintenance. Equipment wear records, standards. Equipment used in predictive maintenance. Computerized maintenance, Total Productive Maintenance. • Methods of condition monitoring, Non-destructive testing, Liquid Penetrate, Magnetic particles, Ultrasonic testing, and Vibration analysis. Oil analysis, Radiographic testing. • Conclusion of Unit including Real Life Application

C. RECOMMENDED STUDY MATERIAL

Sr. No	Book	Author	Edition	Publication
a. Reference Books				
1.	Reliability Evaluation of Engineering and Systems	R.Billintan& R.N. Allan	Latest	Plenum Press.
2.	Reliability in Engineering and Design	K.C. Kapoor & L.R. Lamberson	Latest	John Wiely and Sons.
3.	Life Testing and Reliability Estimation	S.K. Sinha & B.K. Kale	Latest	Wiely Eastern Ltd.
4.	Probabilistic Reliability, An Engineering Approach	M.L.Shooman	Latest	McGraw Hill.
5.	System Reliability Engineering	G.H.Sandler	Latest	Prentice Hall.
b.Websites				
• www.nptel.com • en.wikipedia.org/wiki/Reliability_engineering.. • web.utk.edu/~kkirby/IE591/ReliabEg_1.pdf				

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	–	–	–	–	–	–	–	–
CO2	3	2	2	2	–	–	–	–	–	–	–	–
CO3	3	2	2	2	–	–	–	–	–	–	–	–
CO4	3	2	2	2	–	–	–	–	–	–	–	–
CO5	3	2	2	2	–	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	2	–	–
CO2	1	–	–
CO3	2	–	–
CO4	2	–	–
CO5	2	–	–

Note: On the basis of mapping of COs with POs, this course is related to Employability.

Code: BMECME8201	CNC PROGRAMMING LAB	1 Credit [LTP: 0-0-2]

COURSE OUTCOME

The student will be able to:

CO1 Explain about the codes (G-code and M-Code) used in CNC machines for programming

CO2 Create part program for turning operation in CNC Machine

CO3 Create part program for milling operation on CNC Machine

CO4 Create part program for drilling operation on CNC Machine

CO5 Demonstration of CNC machine with user interface.

A. LIST OF EXPERIMENTS:

1	To study the characteristic features of CNC machine
2	To prepare part programming for plain turning operation.
3	To prepare part programming for turning operation in absolute mode.
4	To prepare part program in inch mode for plain turning operation.
5	To prepare part program for slot milling operation.
6	To prepare part program for drilling operation.
7	To prepare part program for multiple drilling operation in Z-axis.
8	Write the CNC Milling part programming for a given geometry using tool radius compensation.
9	To prepare CNC Milling part program for a drilling of holes using pack drilling cycle and repeat loop feature
10	Demonstration of CNC milling machine with user interface and calculation of coordinates of given geometry in absolute & incremental mode of cutter path.
Virtual Lab	
1	http://vlabs.iitkgp.ac.in/cim/#
2	https://www.malinc.com/products/virtual-cnc/

B. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	–	2	–	–	–	–	–	–	–
CO2	2	3	2	–	2	–	–	–	–	–	–	–
CO3	3	2	2	–	3	–	–	–	–	–	–	–
CO4	2	2	2	–	2	–	–	–	–	–	–	–
CO5	3	2	2	–	2	–	–	–	–	–	–	–

C. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	—	2	–
CO2	—	2	–
CO3	—	3	–
CO4	—	2	–
CO5	—	2	–

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill

Code: BMECME8202	COMPUTER AIDED DESIGN LAB - II	1 Credit [LTP: 0-0-2]

Course outcomes

The student will be able to:

CO1 Illustrate and apply commands of Inventor Modeling Software on 3D-Part modeling components.

CO2 Apply command on assembly of 3D – Part modeling of a components.

CO3 Develop a Plummer block, automobile component (Piston) and Screw jack using Inventor modeling software.

CO4 Create an assembly of Flange coupling, Plummer block, Screw jack in 3D using Inventor modeling software.

CO5 Simulate of Slider crank mechanism in 3D using Inventor modeling software.

A. LIST OF EXPERIMENTS

1.	Study and practice on working features and commands of Inventor Modeling Software.
2.	3D – Part modeling of a component –I
3.	3D – Part modeling of a component –II
4.	3D –Part modeling of a component- III
5.	3D –Part modeling of a component- IV
6.	3D Part modeling of Plummer block using Inventor modeling software
7.	3D –Part modeling of a automobile component (Piston) using Inventor modeling software
8.	3D Part Modeling of Screw jack using Inventor modeling software
9.	Assembly of Flange coupling in 3D using Inventor modeling software
10.	Assembly of Plummer block in 3D using Inventor modeling software
11.	Assembly of Screw jack in 3D using Inventor modeling software –II
12.	Animation of Screw jack in 3D using Inventor modeling software
13.	Animation of Slider crank mechanism in 3D using Inventor modeling software

Virtual Labs	
1	http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/labs/exp1/index.php
2	http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/labs/exp3/index.php
3	http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/labs/exp2/index.php
4	http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/labs/exp5/index.php

D. CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	2	–	–	–	–	–	–	–
CO2	2	2	2	2	3	–	–	–	–	–	–	–
CO3	2	2	2	2	3	–	–	–	–	–	–	–
CO4	3	2	2	2	2	–	–	–	–	–	–	–
CO5	2	2	2	2	3	–	–	–	–	–	–	–

E. CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	–
CO2	–	3	–
CO3	–	3	–
CO4	–	2	–
CO5	–	3	–

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill

Code: BMECME8203	Programming in MATLAB	1 Credit [LTP: 0-0-2]

COURSE OUTCOME

The student will be able to:
CO1 To learn features of MATLAB as a programming tool.
CO2 To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
CO3 To understand MATLAB graphic feature and its applications.
CO4 To use MATLAB as a simulation tool.

A. LIST OF EXPERIMENTS:

1	Arithmetic Operators and all formats of variables.
2	Array and Matrix (access and operations).
3	Creates graphs and plots in 2-Dimensions (2D)
4	Creates graphs and plots in 3-Dimensions (3D)
5	Start working with m-file. (Multiple programs for practice).
6	Multiple programs for practice based on Mechanics/Mechanical branch subjects
7	Solving programs based on Symbolic Mathematics (like algebra, calculus, etc.)
8	Solving programs based on Symbolic Mathematics (like differential, integrals etc.)
9	Simulink tool
10	Multiple programs for creating block diagrams of a problem, practice based on Mechanics/Mechanical branch subjects
Virtual Lab	
1	https://www.mathworks.com/videos/virtual-labs-with-matlab-and-simulink-1605544954052.html
2	https://www.youtube.com/watch?v=O41BWhXFu8E&list=PLRWKj4sFG7-6_Xr9yqg6SMr_F80KdFVhN&index=2&ab_channel=MATLABProgrammingforNumericalComputation

Co- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	3	–	–	–	–	–	–	–
CO2	3	2	2	2	3	–	–	–	–	–	–	–
CO3	3	2	2	2	3	–	–	–	–	–	–	–
CO4	3	2	2	2	2	–	–	–	–	–	–	–
CO5	3	2	2	2	3	–	–	–	–	–	–	–

Co- PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	–	2
CO2	–	–	3
CO3	–	–	3
CO4	–	–	2
CO5	–	–	3

Note: On the basis of mapping of COs with POs, this course is related to Employability and skill

Code: BMECME8301	MAJOR PROJECT	10 Credits [LTP: 0-0-20]

1. The Project group in seventh term will continue the project work in eighth term and complete project in all respect (assembly, testing, fabrication, tabulation, test result etc.)
2. The group should maintain a logbook of activities. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by guide.
3. The guides should regularly monitor the progress of the project work.
4. The project work along with project report should be submitted as part of term work in eighth term on or before the last day of the eighth term
5. Project report must be submitted in the prescribed format only. No variation in the format will be accepted.
6. Assessment of the project for award of marks shall be done by the guide and a departmental committee.
7. The guide should be internal examiner for oral examination.
8. The external examiner should be from the related area of the concerned project. He should have experience at degree level / industry.
9. The evaluation at final oral examination should be done jointly by the internal and external examiners.

CO- PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	–	–	–	–	2	–	2	3	2	–	3
CO2	2	–	–	–	–	2	–	2	3	2	–	3
CO3	2	–	–	–	–	2	–	2	3	2	–	3
CO4	2	–	–	–	–	2	–	2	3	1	–	3
CO5	2	–	–	–	–	2	–	2	3	2	–	3

CO-PSO Mapping

	PSO 1	PSO 2	PO 3
CO1	–	2	2
CO2	–	2	2
CO3	–	2	3
CO4	–	2	2
CO5	–	2	3

Note: On the basis of mapping of COs with POs, this course is related to Employability.