NOTE

The Study Scheme and the detailed contents of various courses for 2018 admission batch onwards are based upon the suggestions and corrections incorporated in BOS (Mechanical Engineering) meeting held on 24/10/2019 (Ref. No. ME/36/4833 dated 4-11-2019).

Study Scheme
B. Tech. (Mechanical Engineering)
2018 Admission Batch Onwards
(Finalized in Meeting of BOS (ME) held on 24.10.2019)

Third Semester (GNDEC)										
Category	**Code**	**Course Title**	**Subject Type (Theory / Practical)**	**Hours per Week**			**Marks Distribution**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
Engineering Science Courses	ESME-101	Engineering Mechanics	Theory	3	0	0	40	60	100	3
Professional Core Courses	PCME-101	Thermodynamics	Theory	3	0	0	40	60	100	3
Professional Core Courses	PCME-102	Strength of Materials	Theory	3	1	0	40	60	100	4
Professional Core Courses	PCME-103	Manufacturing Processes	Theory	3	0	0	40	60	100	3
Professional Core Courses	PCME-104	Machine Drawing and Computer Aided Design	Theory	1	0	4	40	60	100	3
Professional Core Courses	PCME-105	Engineering Materials and Metallurgy	Theory	3	0	0	40	60	100	3
Professional Core Courses	LPCME-101	Strength of MaterialsLaboratory	Practical	0	0	2	30	20	50	1
Professional Core Courses	LPCME-102	Engineering Materials and Metallurgy Laboratory	Practical	0	0	2	30	20	50	1
Professional Core Courses	LPCME-103	Manufacturing Processes Laboratory	Practical	0	0	2	30	20	50	1
Training	TR-101	Training - I*	Practical	-	-	-	60	40	100	1
Mentoring and Professional Development		Mentoring and Professional Development	Practical	0	0	1	-	-	-	-
Total				**16**	**1**	**11**	**390**	**460**	**850**	**23**
Grand Total Contact Hours per week = 27+1#										

*Students will have to undergo Training- I in the college Workshops at the end of 2nd Semester for Four (04) weeks duration.
There will be one period per week for Mentoring and Professional Development; final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

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Study Scheme
B. Tech. (Mechanical Engineering)
2018 Admission Batch Onwards
(Finalized in Meeting of BOS (ME) held on 24.10.2019)

Fourth Semester (GNDEC)										
Category	**Code**	**Course Title**	**Subject Type (Theory / Practical)**	**Hours Per Week**			**Marks Distribution**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
Professional Core courses	PCME-106	Theory of Machines	Theory	3	1	0	40	60	100	4
Professional Core courses	PCME-107	Applied Thermodynamics	Theory	3	1	0	40	60	100	4
Basic Science Course	BSME-101	Mathematics III	Theory	3	0	0	40	60	100	3
Professional Core courses	PCME-108	Fluid Mechanics and Machinery	Theory	3	1	0	40	60	100	4
Professional Core courses	PCME-109	Modern Manufacturing Processes	Theory	3	0	0	40	60	100	3
Professional Core courses	LPCME-104	Theory of Machines Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCME-105	Applied Thermodynamics Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCME-106	Fluid Mechanics and Machinery Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCME-107	Modern Manufacturing Processes Laboratory	Practical	0	0	2	30	20	50	1
Mandatory Courses	MPD-102	Mentoring and Professional Development*	Practical	**0**	**0**	**1**	100*	0	100*	1
Total				**15**	**3**	**9**	**420**	**380**	**800**	**23**

Grand Total Contact Hours per Week = 27

*Final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

Note:

- During this semester, each student has to visit the selected local industry five times in such a way that he/she has to make at least one visit in that industry each month.
- He/She has to maintain a record of each visit in a diary. The evaluation of these Industrial visits will be done by a committee consisting of faculty members at the end of the semester out of 20 marks.
- These marks will become part of internal marks for the Industrial Training/ Institutional Training-Iprovided in 5th semester study scheme.
- Each student has to undergo Four (04) weeks Industrial Training (preferably in the same industry)/ Institutional Training viz.IITs/NITs/R&D Labs/ GNDEC only at the end of 4th Semester. For writing the report the students have to follow the concerned guidelines.

Study Scheme
B. Tech. (Mechanical Engineering)
2018 Admission Batch Onwards
(Finalized in Meeting of BOS (ME) held on 24.10.2019)

Fifth Semester (GNDEC)										
Category	**Code**	**Course Title**	**Subject Type (Theory / Practical)**	**Hours Per Week**			**Marks Distribution**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
Professional Core courses	PCME-110	Finite Element Method	Theory	2	0	0	40	60	100	2
Professional Core courses	PCME-111	Design of Machine Elements	Theory	3	1	0	40	60	100	4
Professional Core courses	PCME-112	Heat Transfer	Theory	3	1	0	40	60	100	4
Humanities and Social Sciences including Management Courses	HSMME-101	Operation Research	Theory	3	0	0	40	60	100	3
Professional Core courses	PCME-113	Mechanical Measurement and Control	Theory	3	0	0	40	60	100	3
Professional Core courses	PCME-114	Industrial Automation and Robotics	Theory	3	0	0	40	60	100	3
Professional Core courses	LPCME-108	Industrial Automation and Robotics Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCME-109	Mechanical Measurement and Control Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCME-110	Heat Transfer Laboratory	Practical	0	0	2	30	20	50	1
Training	TR-102	Training –II*	Practical	-	-	-	60	40	100	1
Mentoring and Professional Development		Mentoring and Professional Development	Practical	0	0	1	-	-	-	-
Total				**17**	**02**	**07**	**390**	**460**	**850**	**23**

Grand Total Contact Hours per Week = 25+1#

There will be one period per week for Mentoring and Professional Development; final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

i. *The marks of Industrial Training (preferably in the same industry)/Institutional Training-I (at IITs/NITs/ R&D Labs//GNDEC only) undergone at the end of 4th Semester will be included here.

ii. * Evaluation scheme of Industrial/ Institutional Training-I shall be as under:-

Internal: Out of 60 marks, 20 marks will be given on the basis of industrial visits made by the student during 4th semester. The students have to visit the selected local industry five times in the semester in such a way that in each month he/she has to make at least one visit in the same industry. He has to maintain a diary for recording the report of each visit. 40 marks shall be given on the basis of evaluation as per the rubrics.

External: External examiner should be essentially from industry and will evaluate the students on the basis of oral viva for 40 marks.

Study Scheme
B. Tech. (Mechanical Engineering)
2018 Admission Batch Onwards
(Finalized in Meeting of BOS (ME) held on 24.10.2019)

Sixth Semester (GNDEC)										
Category	Code	Course Title	Subject Type (Theory / Practical)	Hours Per Week			Marks Distribution		Total Marks	Credits
				L	T	P	Internal	External		
Professional Core courses	PCME-115	Mechanical Vibrations	Theory	3	0	0	40	60	100	3
Professional Core courses	PCME-116	Refrigeration and Air Conditioning	Theory	3	1	0	40	60	100	4
Professional Elective courses	PEME- XXX	Elective – I	Theory	4	0	0	40	60	100	4
Professional Elective courses	PEME- XXX	Elective – II	Theory	4	0	0	40	60	100	4
Professional Core courses	LPCME-111	Mechanical Vibrations Laboratory	Practical	0	0	2	40	60	100	1
Professional Core courses	LPCME-112	Refrigeration and Air Conditioning Laboratory	Practical	0	0	2	40	60	100	1
Open Elective courses	OEZZ- XXX	Open Elective – I*	Theory	3	0	0	30	20	50	3
Project Work, Seminar and Internship in Industry or Appropriate Work Place/ Academic and Research in India/Abroad	PRME-101	Minor Project cum Seminar**	Practical	0	0	4	60	40	100	2
Mandatory Courses	MPD-103	Mentoring and Professional Development***	Practical	0	0	1	100***	0	100	1
Mandatory Courses(Non-Credit)	MCI-101	Constitution of India	Theory	2	0	0	40	60	100	NC
Total				19	01	09	470	480	950	23

Grand Total Contact Hours per Week = 29

*The open elective will be taken by a student offered by other departments, and not by his/her own department.

**The minor project cum seminar will be carried out to enhance the technical report writing and presentation skills alongwithliterature survey, problem formulation, assessment for viability of the project, objectives,methodology and minor theoretical/ experimental analysis for the project. The minor project may be carried out by a group of students (2 to 4). The evaluation of the minor project will be done as per the rubrics. For writing the report the students have to follow the concerned guidelines.

***Final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

Note:-

- Each student has to undergo Six (06) weeks Industrial Training /Institutional Training viz. IITs/NITs/R&D Labs/ GNDEC only at the end of 6th Semester.For writing the report the students have to follow the concerned guidelines.

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Study Scheme
B. Tech. (Mechanical Engineering)
2018 Admission Batch Onwards
(Finalized in Meeting of BOS (ME) held on 24.10.2019)

Seventh Semester (GNDEC)										
Category	Code	Course Title	Subject Type (Theory / Practical)	Hours Per Week			Marks Distribution		Total Marks	Credits
				L	T	P	Internal	External		
Professional Elective courses	PEME- XXX	Elective – III	Theory	4	0	0	40	60	100	4
Professional Elective courses	PEME- XXX	Elective – IV	Theory	4	0	0	40	60	100	4
Open Elective courses	OEZZ- XXX	Open Elective – II	Theory	3	0	0	40	60	100	3
Project Work, Seminar and Internship in Industry or Appropriate Work Place/ Academic and Research in India/Abroad	PRME-102	Project -I *	Practical	0	0	6	120	80	200	3
Training	TR-103	Training - III**	Practical	-	-	-	120	80	200	2
Mandatory Courses (Non-credit)	MCI-102	Environmental Science	Theory	2	0	0	40	60	100	NC
Mentoring and Professional Development		Mentoring and Professional Development	Practical	0	0	1	-	-	-	-
Total				13	0	7	400	400	800	16

Grand Total Contact Hours per Week =19+1#

There will be one period per week for Mentoring and Professional Development; final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

*In Project – I the problem related with design/construction/fabrication/computer modeling/experimentation etc. based on specialization group of electives is to be carried out. The results and analysis followed by discussion regarding suitability /non suitability of the project or any positive gain in the project made with conclusions and recommendations for future extension of the project must be covered. The evaluation of Project - I will be done as per the rubrics. For writing the report the students have to follow the concerned guidelines.
The Project - I may be carried out by a group of students (2 to 4students from same specialization group). The same project problem may be extended in the Project - II in 8th semester.

**i. The marks of Industrial / Institutional Training-II (at IITs/NITs/ R&D Labs//GNDEC only) undergone at the end of 6th Semester will be included here.
ii. Each student has to do atleast one project in concerned Industry/ Institution
iii. Evaluation scheme of Industrial/ Institutional Training-II shall be as under:-
Internal: 120 marks shall be given on the basis of evaluation as per the rubrics.
External: External examiner from industry / Institution will evaluate the students on the basis of viva-voce for 80 marks.

Study Scheme
B. Tech. (Mechanical Engineering)
2018 Admission Batch Onwards
(Finalized in Meeting of BOS (ME) held on 24.10.2019)

Eight Semester (GNDEC)										
Category	**Code**	**Course Title**	**Subject Type (Theory / Practical)**	**Hours Per Week**			**Marks Distribution**		**Total Marks**	**Credits**
				L	**T**	**P**	**Internal**	**External**		
Professional Elective courses	PEME-XXX	Elective – V	Theory	4	0	0	40	60	100	4
Professional Elective courses	PEME- XXX	Elective – VI	Theory	4	0	0	40	60	100	4
Open Elective courses	OEZZ-XXX	Open Elective – III	Theory	3	0	0	40	60	100	3
Project Work, Seminar and Internship in Industry or Appropriate Work Place/ Academic and Research in India/Abroad	PRME-103	Project –II*	Practical	0	0	6	120	80	200	3
Mandatory Courses	MPD-104	Mentoring and Professional Development**	Practical	0	0	1	100**	0	100	1
Mandatory Courses (Non-credit)	MCI-103	Essence of Indian Traditional Knowledge	Theory	2	0	0	40	60	100	NC
Total				**13**	**0**	**7**	**380**	**320**	**700**	**15**

Grand Total Contact Hours per Week = 20

*In Project – II the problem related with design/construction/fabrication/computer modeling/experimentation etc. based on specialization group of electives is to be carried out. The results shall be based on theoretical as well as experimental analysis followed by discussion regarding suitability /non suitability of the project or any positive gain in the project. The conclusions and recommendations for future extension of the project must be covered. The evaluation of Project - II will be done as per the rubrics. For writing the report the students have to follow the concerned guidelines.
The Project - II may be carried out by a group of students (2 to 4 from same specialization group).
**Final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

Overall Contact hours per Week = 150
Overall Credits = 124
Overall Maximum Marks = 4950

PROFESSIONAL ELECTIVE COURSES

I. SPECIALIZATION GROUP

(1) THERMAL

PEME - 101	Internal Combustion Engines
PEME - 102	Cryogenic Technologies
PEME - 103	Non Conventional Energy resources
PEME - 104	Energy Conservation and Management
PEME - 105	Fluid Mechanics –II
PEME - 106	Heat Exchanger Design
PEME - 107	Solar Energy
PEME - 108	Power Plant Engineering
PEME - 109	Computational Fluid Dynamics
PEME - 110	Automobile Engineering
PEME - 111	Gas Dynamics and Jet Propulsion

(2) DESIGN

PEME - 201	Design for X
PEME - 202	Product Design and Development
PEME - 203	Machine Tool Design
PEME - 204	Tool Design
PEME - 205	Experimental Stress Analysis
PEME - 206	Industrial Tribology
PEME - 207	Theory of Plasticity
PEME - 208	Process Planning and Cost Estimation
PEME - 209	Mechatronics
PEME - 210	Finite Element Method
PEME - 211	Modeling and Simulation
PEME - 212	Optimization Techniques
PEME - 213	Computer Aided Design
PEME - 214	Microprocessors in Automation
PEME - 215	Design of Transmission Systems

(3) MANUFACTURING

PEME - 301	Non-Traditional Machining
PEME - 302	Modern Welding and Forming Processes
PEME - 303	Computer integrated Manufacturing
PEME - 304	Computer Aided Process planning
PEME - 305	Machining Science
PEME - 306	Rapid Prototyping

PEME - 307	Characterizations of Materials
PEME - 308	Surface Science
PEME - 309	Modern Casting Processes
PEME - 310	Micromachining Technologies
PEME - 311	Manufacturing Systems
PEME - 312	Non -Destructive Testing
PEME - 313	Heat Treatment Processes
PEME - 314	Plastic Technologies
PEME - 315	Composite Materials
PEME - 316	Process Planning and Cost Estimation

II. OPEN ELECTIVE COURSES (for other branches)

OEME - 101	Industrial Safety and Environment
OEME - 102	Management Information System
OEME - 103	Entrepreneurship
OEME - 104	Operations Management
OEME - 105	Total Quality Management
OEME - 106	Industrial Engineering
OEME – 107	Non Conventional Energy Resources
PCME – 113/OEME – 108	Heat Transfer
PCME – 114/OEME – 109	Mechanical Measurement and Control
HSMME-101/OEME – 110	Operation Research
PCME-115/OEME – 111	Industrial Automation and Robotics

Subject Code: ESME-101 **Subject Name: Engineering Mechanics**

Programme: B.Tech.(ME)	**L:** 3 **T:** 0 **P:** 0
Semester: 3	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 70%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites:

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Understand the meaning of Engineering Mechanics.
2	Solve the problem related to the behaviour of a rigid body due to an external load.
3	Solve, analyze and design moment of area of plane figures.
4	Analyze the mass moment of solid objects.
5	Apply the Work-Energy Equation and Impulse-Momentum equation.
6	Analysis and Solve friction related problems.

Detailed Contents:

Part-A

1. **Basics and Statics of particles:** Introduction: Units and Dimensions ; Laws of Mechanics : Lami's theorem, Parallelogram and triangular; Law of forces: Vectorial representation of forces , Vector operations of forces: additions, subtraction, dot product, cross product ; Coplanar Forces : rectangular components ; Equilibrium of a particle, Forces in space , Equilibrium of a particle in space , Equivalent systems of forces , Principle of transmissibility. **07 Hrs**

2. **Equilibrium of Rigid Bodies:** Types of supports; Free body diagram; Action and reaction forces; stable equilibrium ; Moments and Couples : Moment of a force about a point and about an axis, Vectorial representation of moments and couples , Scalar components of a moment; Varignon's theorem: Single equivalent force, Equilibrium of Rigid bodies in two dimensions ,Equilibrium of Rigid bodies in three dimensions. **07 Hrs**

3. **Properties of Surfaces and Solids:** Centroids and centre of mass; Centroids of lines and areas: Rectangular, circular, triangular areas by integration, T section, I section, Angle section, Hollow section by using standard formula ; Theorems of Pappus: Area moments of inertia of plane areas: Rectangular, circular, triangular areas by integration, T section, I section, Angle section, Hollow section by using standard formula ; Parallel axis theorem and perpendicular axis theorem : Principal moments of inertia of plane areas, Principal axes of inertia, Mass moment of inertia ;mass moment of inertia for prismatic, cylindrical and spherical solids from first principle; Relation to area moments of inertia. **07 Hrs**

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Part-B

4. **Friction:** Friction force: Laws of sliding friction, equilibrium analysis of simple systems with sliding friction, wedge friction; Rolling resistance. **04 Hrs**
5. **Dynamics of Particles:** Displacements, Velocity and acceleration, their relationship, Relative motion, Curvilinear motion; Newton's laws of motion ; Work Energy Equation; Impulse and Momentum; Impact of elastic bodies. **07 Hrs**
6. **Dynamics of Rigid Bodies and its application:** Translation and Rotation of Rigid Bodies, Velocity and acceleration, General Plane motion of simple rigid bodies such as a cylinder, disc/wheel, and sphere. **04 Hrs**

Text Books

1. Russell C. Hibbeler, *"Engineering Mechanics: Statics & Dynamics"*, Pearson Publishers 14th Edition, 2016.
2. R.K. Banal, *"Engineering Mechanics"*, Luxmi publishers" 8th Edition, 2016.
3. Irving H. Shames, *"Engineering Mechanics"*, Prentice Hall, 4th Edition, 2006
4. R. C. Hibler and Ashok Gupta, *"Engineering Mechanics (Statics, Dynamics)"*, Pearson Education,11th Edition,2010
5. F. P. Beer and E. R. Johnston, *"Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics"*, Tata McGraw Hill Publishing, 9th Edition, 2011

Reference Books

1. K. L Kumar, *"Engineering Mechanics"*, Tata McGraw-Hill Publishing Company, 3rd Edition 2008.
2. S Rajasekaran and G. Sankarasubramanian, *"Engineering Mechanics Statics and Dynamics"*, Vikas Publishing House Pvt. Ltd., 3rd Edition, 2005.
3. E. Nelson, Charles Best, William Mclean, Merle Potter, *"Schaum's Outline of Engineering Mechanics: Statics"*, McGraw-Hill Education; 6thEdition, 2010. (E-Book Available)
4. E. Nelson, Charles Best, William Mclean, Merle Potter, *"Schaum's Outline of Engineering Mechanics Dynamics"*, McGraw-Hill Education, 2010. (E-Book Available)
5. Robert W. Messler Jr., *"Reverse Engineering: Mechanisms, Structures, Systems & Materials"*, McGraw-Hill Education, 1st Edition, 2013). (E-Book Available)

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Subject Code: PCME-101 **Subject Name: Thermodynamics**

Programme: B.Tech.(ME)	**L:** 3 **T:** 0 **P:** 0
Semester: 3	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 70%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites:

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Understand and use basic concepts and First Law of Thermodynamics for engineering applications.
2	Apply the Second law of Thermodynamics and related properties for the feasibility of engineering systems and solve engineering problems.
3	Recognize the nature of substance from the understanding of its properties and use related Tables and Charts.
4	Evaluate and analyze the performance of Air Standard and Vapor power cycles.
5	Apply combustion equations to analyze the products of combustion and combustion phenomenon.
6	Select IC Engine for a particular application.

Detailed Contents:

PART-A

1. **Basic concepts and First law of Thermodynamics:** Brief concept of continuum, Thermodynamic System, Boundary and Surroundings, Control(fixed) mass and Control Volume concept, Thermodynamic State, Thermodynamic Property, Condition for any quantity to be a property, Thermodynamic equilibrium, Thermodynamic path, Thermodynamic process, Concept of reversible process, Quasi-static process, Irreversible process, Cyclic process, Thermodynamic Cycle, Energy and its forms; Physical insight to internal energy, Energy transfer across system boundary i.e. transient energies, Heat and work transfer- their comparison and sign conventions, Displacement work and other modes of work, Zeroth law of Thermodynamics, First law of Thermodynamics and its applications to closed and open system, Steady and unsteady flow processes. **06 Hrs**

2. **Second law of Thermodynamics:** Limitations of first law of Thermodynamics, Heat reservoir, source and sink, Heat engine, Refrigerator, Heat pump, Kelvin-Plank and Clausius Statements of second law and their corollaries, Carnot and reversed Carnot cycle, Concept of entropy, T-S diagram, Principle of increase in entropy, Applications of second law, High grade and low grade energy, Available and non-available energy, Enthalpy and entropy as a function of independent variables, Third law of Thermodynamics. **08 Hrs**
3. **Properties of pure substances and Gas Mixtures:** Formation of steam and its Thermodynamic properties, p-V, T-S and an h-s diagram for a pure substance, Use of the

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steam table and Mollier chart, Determination of dryness fraction, Equation of State of a Gas, Ideal Gas, Internal energy, Enthalpy and Entropy of Gas Mixtures. **06 Hrs**

PART-B

4. **Thermodynamic cycles:** Air standard cycle: Otto cycle, Diesel cycle, Dual cycle and Brayton cycle; Vapor power Cycles: Steam power cycles, Rankine Cycles, Comparison of Rankine and Carnot Cycles, Reheat Cycle, Regenerative Cycles, Reheat – Regenerative Cycle, Binary Vapor Cycles, Thermodynamics of combined cycles. **08 Hrs**
5. **Combustion of fuel:** Types of fuels, Combustion of fuel, Combustion equations, Minimum air requirements and air-fuel ratio, Wet and dry analysis of products of combustion, Conversion of volumetric analysis into gravimetric analysis and vice-versa, Enthalpy of formation, Enthalpy of reaction, Adiabatic flame temperature. **08 Hrs**
6. **Introduction to IC Engines:** Introduction to heat engines; Merits of I.C. Engines and their important applications, Classification and constructional features of I.C. Engines; Working of two stroke and four stroke Petrol and Diesel engines and their comparison. **04 Hrs**

Text Books:

1. P.K. Nag, *"Engineering Thermodynamics"*, McGraw Hill Education (India), Chennai, 6th Edition 2017.
2. V. Ganeshan, *" Thermal Engineering"*, McGraw Hill Education (India), Chennai
3. Y.A. Cengel, M. A. Boles, *"Thermodynamics – An Engineering Approach"*, McGraw Hill Education, 8th Edition 2017.
4. R. E. Sonntag, C. Borgnakke, & G. J. V. Wylen, *"Fundamentals of Thermodynamics"*, Wiley, 7th Edition 2009.
5. M. J. Moran, H. N. Shapiro, D. D. Boettner & M. Bailey, *"Fundamentals of Engineering Thermodynamics"*, John Wiley & Sons, 7th Edition, 2010.

Reference Books:

1. J. B. Jones, & R. E. Dugan, *"Engineering Thermodynamics"*, Prentice Hall, 1st Edition 1995.
2. D.B. Spalding, E.H. Cole, *"Engineering Thermodynamics"*, Edward Arnold, London,1982.
3. V.G. Erokhim, M.G. Makhan, *"Fundamentals of Thermodynamics and Heat Engines"*, Mir Publishers, Moscow, 1986.
4. I. Shvets, V. Tolubinsky, *"Heat Engineering"*, MedTech Science and Technology Series, 2nd Edition 1975.

Topics for Self Learning (TSL)
1. Concept of Irreversibility
2. Types of steam generators
3. Gibbs Function of a mixture
4. Maxwell's Equations
5. Combustion phenomenon in IC Engines (Knocking and detonation)

05/07/2019

Subject Code: PCME-102 **Subject Name: Strength of Materials**

Programme: B.Tech. (ME)	**L:** 3 **T:** 1 **P:** 0
Semester: 3	**Teaching Hours:** 39
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 70%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites:

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Formulate mechanics problems using calculus and differential equations.
2	Solve, analyze and design beams under bending stresses.
3	Understand the design considerations of structures subjected to different/wide range of loading conditions including thermal loads.
4	Relate the design problems with practical applications.
5	Solve problem involving simple and combined modes, including torsion.
6	Evaluate slope and deflection in different type of beams under different loading conditions.

Detailed Contents:

Part-A

1. **Simple Stresses and Strains:** Stress and Strain and their types, Hook's law, longitudinal and lateral strain, Poisson's ratio, stress-strain diagram for ductile and brittle materials, extension of a bar due to without and with self-weight, bar of uniform strength, stress in a bar, elastic constants and their significance, relation between elastic constants, Young's modulus of elasticity, modulus of rigidity and bulk modulus. Thermal stresses and strains: Temperature stress and strain calculation due to axial load and variation of temperature in single and compound bars. **07 Hrs**
2. **Principal Stresses and Strains**: Two-dimensional stress system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle for stresses and strains, principal stresses related to principal strains. Strain energy: Introduction to strain energy, strain energy in simple tension and compression. Stresses develop due to a different type of loads. Strain energy in pure shearing, torsion, and due to bending; Theories of failure: Maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, total strain energy theory, shear strain energy theory. Graphical representation and derivation of the equation for these theories and their application to problems related to two-dimensional stress systems. **07 Hrs**
3. **Bending Moment (B.M) and Shear Force (S.F) Diagrams:** Shear force and Bending Moment definitions; relation between load, shear force and bending moment; B.M and S.F diagrams for cantilevers, simply supported beams with or without overhangs, and calculation of maximum bending moment, Shear force and Point of contra flexure under the

following type of loads: a) Concentrated loads b) Uniformity distributed loads over the whole span or part of span c) Combination of concentrated and uniformly distributed load d) Uniformly varying loads e) Application of moments. **07Hrs**

Part-B

4. **Bending Stresses in Beams:** Bending theory; assumptions, derivation of bending equation and its application to beams of rectangular, circular and channel, I and T- sections. Combined, direct and bending stresses in afore-mentioned sections, composite / flitched beams **04 Hrs**
5. **Torsion:** Derivation of torsion equation, its assumptions and application on the hollow and solid circular shafts. Torsional rigidity, combined torsion and bending of circular shafts, principal stresses and maximum shear stresses under combined loading of bending and torsion. **04 Hrs**
6. **Deflection in beams:** Relationship between moment, slope and deflection, Double integration method, Macaulay's method, moment area method and use of these methods to calculate slope and deflection for the following: a. Cantilevers b. simply supported beams with or without overhang under concentrated loads, uniformly distributed loads or combination of concentrated & uniformly distributed loads. **07Hrs**
7. **Thin cylinders and spheres:** Calculation of Hoop stress, longitudinal stress in a cylinder, the efficiency of joints, changes in dimensions due to internal pressure. Principal stresses in a spherical shell, change in diameter and internal volume. **02Hrs**

Text Books

1. S.S. Rattan, *"Strength of Materials"*, Tata McGraw Hill, 11th Edition, 2014 (E-Book).
2. R.S. Lehri, *"Strength of Materials"*, Katson, 11th Edition, 2012.
3. Egor P. Popov, *"Engineering Mechanics of Solids"*, Prentice Hall of India,2nd Edition,2001.
4. R. Subramanian, *"Strength of Materials"*, Oxford University Press, 3rd Edition, 2007.
5. Timoshenko, *"Mechanics of Materials"*, CBS Publication, 2nd Edition, 2006.

Reference Books

1. Kirpal Singh, *"Mechanics of Materials"*, Standard Publishers, 7th Edition, 2013.
2. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, *"Mechanics of Materials"*, Tata Mc-GrawHill Publishing Co. Ltd., 2005.
3. Sadhu Singh, *"Strength of Materials"*, Khanna Publication, 11th Edition, 1978.
4. Russell C. Hibbeler, *"Mechanics of Materials"*,Pearson Publications, 10th Edition, 2016.

Subject Code: PCME-103 **Subject Name: Manufacturing Processes**

Programme: B.Tech.(ME)	**L:** 3 **T:** 0 **P:** 0
Semester: 3	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites: Manufacturing Practices
Additional Material Allowed in ESE: [Scientific Calculator]
On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Use the Knowledge of Fundamental principles of Castings, Welding, forming and cutting processes for their practical applications.
2	Identify and suggest equipment, tools and accessories required for performing the various manufacturing processes.
3	Know about cutting tools and their materials and related concepts like tool life, wear, and coolants/lubricants.
4	Identify various machine tools and knowledge of different parameters of the processes for analyzing their effect.
5	Suggest a suitable process for manufacturing of component.
6	Understand the latest technologies in Manufacturing Processes.

Detailed Contents:

Part-A

1. **Introduction:** Classification of manufacturing processes; Selection criteria for manufacturing processes; General trends in manufacturing. **02Hrs**
2. **Casting Processes:** Introduction to metal casting; Patterns: types, materials and allowances; Moulding materials: moulding sand compositions and properties, sand testing, types of moulds, moulding machines. Cores: function, types, core making process, core-prints, chaplets. Gating system design, Riser design. Melting furnaces, and Metallurgical considerations in casting, Solidification of metals and alloys, Directional solidification, Segregation, Nucleation and Grain growth. **10Hrs**
3. **Welding Processes:** Introduction and classification of welding processes; Principle , Equipment and constructional details for Gas welding, Electric Arc welding, relative merits of AC & DC arc welding; Electrodes: types, selection, electrode coating ingredients and their function; Thermal effects on weldment: heat affected zone, grain size and its control; Resistance welding: principle and their types. TIG and MIG welding processes: principle, equipment and constructional details. **10Hrs**

Part - B

4. **Metal Forming:** Introduction and classification; Rolling process: introduction, classification, rolling mills, products of rolling, rolling defects and remedies; Forging: open and closed die

forging, forging operations, forging defects, their causes and remedies; Extrusion: classification, equipment, defects and remedies; Drawing: drawing of rods, wires and tubes, drawing defects and remedies; Introduction to sheet metal forming operations. **06Hrs**

5. **Metal Cutting:** Introduction to machining processes; Cutting tool geometry, Cutting tool materials: high carbon steels, alloy carbon steels, high-speed steel, cast alloys, cemented carbides, ceramics and diamonds, and CBN; Mechanics of chip formation process, concept of shear angle and cutting forces in metal cutting; Merchant theory, tool wear, tool life, machinability; **05Hrs**
6. **Machine Tools**: Classification, description and operations of Lathe machine, Shaping and planning machine, Milling machine, Boring machine; Broaching machine. **05Hrs**

Text Books

1. P. N. Rao, *"Manufacturing Technology, Foundry, Forming & Welding"*, Tata McGraw Hill, 4th Edition, 2017
2. P. N. Rao, *"Manufacturing Technology, Metal Cutting and Machine Tools"*, Tata McGraw Hill, 4th Edition, 2017
3. B. L. Juneja and G. S. Sekhon, *"Fundamentals of Metal Cutting & Machine Tools"*, New Age International (P) Ltd, 2nd Edition, 2017.
4. P. C. Sharma, *"A Text Book of Production Technology"*, S. Chand & Company Ltd., 8th Edition, 2014.
5. H. S. Shan, "*Manufacturing Processes*", Cambridge University Press, 2nd Edition, 2018.

Reference Books:

1. SeropeKalpakjian and Steven R. Schmid, *"Manufacturing Engineering and Technology"*, Pearson Publishers, 4th Edition, 2002.
2. J.A. Schey, "*Introduction to Manufacturing Processes*" ,McGraw Hill Co., 3rd Edition 2000.
3. G. Boothroyd and W.A. Knight, "*Fundamentals of Machining and Machine Tools*", 2nd Edition, Marcel Dekker, Inc., 1989.
4. Uday S. Dixit, *"Metal Forming: Technology and Process Modeling"*, McGraw-Hill Professional, 2013. (E-book available)
5. HwaiyuGeng, *"Manufacturing Engineering Handbook,"* McGraw-Hill Professional2nd*Edition.*(E-book available)
6. Jonathan Beddoes, M. J.Bibby, *"Principles of Metal Manufacturing Processes"*, Butterworth Heinemann Elsevier Publications.(E-book available)

Subject Code: PCME-104 Subject Name: Machine Drawing and Computer Aided Design

Programme: B.Tech.(ME)	**L:** 1 **T:** 0 **P:**4
Semester: 3	**Teaching Hours:** 60
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 90%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites: Engineering Drawing and Graphics.
Additional Material Allowed in ESE: [Scientific Calculator]
On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	To acquire the knowledge of CAD software and its features.
2	To inculcate an understanding of the detail/assembly drawings using orthographic projections and sectional views.
3	To familiarize the students with Indian Standards on drawing practices.
4	To impart knowledge of thread forms, fasteners, keys, joints and couplings.
5	To make the students interpret drawings of machine components so as to prepare assembly drawings either manually and using CAD packages.
6	To acquire the knowledge of limits fits and tolerance pertaining to machine drawings.

Detailed Contents:

Part–A (Theory)

Traditional Machine Drawing (TMD) and Computer Aided Design (CAD)

1. **Introduction:** Requirements of machine drawing; Review of Sectioning and conventional representation, Dimensioning, Machining Symbols, introduction and Familiarization of Code SP 46:2003. **01Hrs**
2. **Fasteners:** Various types of screw threads, nuts and bolts, screwed fasteners, welding joints, riveted joints, knuckle joint, couplings, keys and cotter. **02Hrs**
3. **Assembly in First Angle Projection of Various Mechanical Components**: Plummer Block, Foot Step Bearing, Steam Stop Valve, spring-loaded Safety Valve, Blow-off Cock, Tail Stock, Screw Jack, Expansion Joint. **03Hrs**
4. **Introduction to CAD:** Introduction to CAD and its role in Product design and development cycle; CAD system; advanced input and output devices; Functions of a graphics package; Digital Printing, Rapid Prototyping, Application areas of CAD. **01Hrs**
5. **Fits and Tolerance:** The concept of limits, fits & tolerances and their representation; types of fits: running , sliding , location, assembly, transition and interference ;ISO system of tolerance , tolerance zones, and grades; tolerance types : dimensional and geometric ; Gauging

Part – B (Practice) TMD and CAD

Use of Traditional Machine Drawing (TMD)

1. Types of sectioning, limits, fits & tolerances; machining and welding symbols. **02 Hrs**
2. Sketches of various fasteners (screw threads, nuts and bolts, screwed fasteners, riveted joints, keys and cotter) **04Hrs**
3. Freehand sketches **06Hrs**

   a) Couplings: Solid or Rigid Coupling, Protected Type Flange coupling, Pin type flexible coupling, muff coupling, universal coupling, cone friction clutch, single plate friction clutch.
   b) **Pulleys:** fast and loose pulleys, stepped pulleys.
   c) Knuckle and cotter joints, keys; Spigot and socket joint, Union joint.
4. **Assembly in First Angle Projection of Various Mechanical Components:** Plummer Block, Foot Step Bearing, Steam Stop Valve, spring-loaded Safety Valve, Blow-off Cock, Tail Stock, Screw Jack. **18 Hrs**

Use of 3D CAD software

5. Practice of 2D drawing using sketcher. **03 Hrs**
6. 3D modelling using 3D features. **06 Hrs**
7. Drafting and assembling of (any one from Plummer Block, bench vice, Screw Jack,Steam Stop Valve, knuckle joint etc.) with proper mating conditions and interference checking using 3D software. **08 Hrs**
8. Surface modelling (Computer mouse; Plastic bottles). **05 Hrs**

Text Books:

1. Ajeet Singh, *"Machine Drawing (including Auto CAD)"*, McGraw Hill, 2nd edition, 2012
2. N.D. Bhatt, *"Machine Drawing"*, Charotar publications,50th Edition, 2014
3. P.S. Gill, *"Machine Drawing"*, S K Kataria and Sons, 18th edition, 2017 Reprint
4. MikellP.Groover, Emory W. Zimmer's, *"CAD/CAM: Computer-Aided Design and Manufacturing"*, PHI, 2nd Edition, 1984.
5. D. D.Bedworth, M. R Henderson & P.M. Wolfe, *"Computer Integrated Design and Manufacturing"*, McGraw Hill,2nd Edition, 1991.
6. Z.Ibraham, *"CAD/CAM - Theory and Practice"*, McGraw Hill, 2nd Edition, 2009.

Reference Books:

1. Gene R. Cogorno,*"Geometric Dimensioning and Tolerancing for Mechanical Design"*, McGraw-Hill Professional, 2nd Edition,2011. (E-Book Available)
2. Paul Drake, Jr., *"Dimensioning and Tolerancing Handbook"*, McGraw-Hill Professional, 1st Edition, 1999.(E-Book Available)
3. Joseph E. Shigley,*"Standard Handbook of Machine Design"*, McGraw-Hill Professional,3rdEdition2004.(E-Book Available)

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Subject Code: PCME 105 **Subject Name: Engineering Materials and Metallurgy**

Programme: B.Tech.(ME)	**L:** 3 **T:** 0 **P:** 0
Semester: 3	**Teaching Hours:** 38
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites: NIL

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Ability to differentiate ferrous and non-ferrous metals.
2	Explain the significance of the metallurgical characteristics of engineering materials (both ferrous and non-ferrous).
3	Explain the theories of diffusion, plastic deformation and re-crystallization.
4	Analyze various heat treatment processes and their applications for ferrous materials.
5	Explain the role of Fe-C and TTT diagram for controlling the desired structure and properties of the materials.
6	Suggest the methods to determine the harden-ability of materials.

Detailed Contents:

Part-A

1. **Ferrous and Non Ferrous Metals:** Introduction, classification and composition of alloy steels, effect of alloying elements (Si, Mn, Ni, Cr, Mo, W, Al) on the structures and properties of steel. Non-Ferrous Metals & Alloys: Aluminum, Magnesium and Copper alloys: Composition, Properties and Applications. **08 Hrs**
2. **Crystallography :**Atomic bonding in solids, crystal systems, crystal lattice of body centered cubic, face centered cubic, closed packed hexagonal; coordination number, APF,c/a ratio of HCP. Crystallographic notation of atomic planes;; imperfection in solids; point defects, line defects and dislocations, interfacial defects, bulk or volume defects. Diffusion: diffusion mechanisms, steady-state and non-steady-state diffusion, factors affecting diffusion. Theories of plastic deformation; slip and twinning, recovery, re-crystallization. **08 Hrs**

Part-B

3. **Heat Treatment:** Principles and applications. Processes viz. annealing, normalizing, hardening, tempering. Surface hardening of steels: Principles of induction and oxyacetylene flame hardening. Procedure for carburizing, nitriding and cyaniding. Harden-ability: determination of harden-ability. Jominy end-quench test. Defects due to heat treatment and their remedies. **10 Hrs.**

4. **Phase Transformation:** General principles of phase transformation in alloys, Types of equilibrium diagrams: Two metals completely soluble in the liquid state and completely soluble in the solid state, Eutectic (Two metals completely soluble in the liquid state but completely insoluble in the solid state & Two metals completely soluble in the liquid state but partly soluble in the solid state), Peritectic, Eutectoid and Peritectoid system. Polymorphism and allotropy; allotropy of iron. Iron carbon equilibrium diagram and various phase transformations. Time temperature transformation curves (TTT curves): fundamentals, construction and applications. **12 Hrs**

Text Books

1. Sidney H Avner, *"Introduction to Physical Metallurgy"*, Tata McGraw-Hill. 2nd Edition, 2017
2. O.P. Khanna, *"A Text book of Materials Science & Metallurgy"*, DhanpatRai& Sons. Re-print 1984
3. U. C. Jindal, *"Material Science and Metallurgy"*, Pearson. Re-print 2011(E book)
4. Parashivamurthy K.I, *" Material science and metallurgy"*, Pearson Re-print 2012(E book)
5. Lakhtin,Yu.M,*"Engineering physical metallurgy and Heat treatment"*, Mir Publishers. Re-print 1986

Reference Books

1. V. Raghavan, *"Physical Metallurgy: Principles and Practice"*, PHI Learning. 3rdEdition 2015
2. B. Zakharov, *"Heat Treatment of Metal"*, University Press.1984
3. George S. Brady, *"Materials Handbook: An Encyclopedia for Managers, Technical Professionals, Purchasing and Production Managers, Technicians, and Supervisors"*, McGraw-Hill Publication, 15thEdition, 2002.
4. Smallman, R.E. Ngan, A.H.W.,*"Modern Physical metallurgy"*Butterworth-Heinemann,8th Edition 2013.

Subject Code: LPCME-101 **Subject Name: Strength of Materials Laboratory**

Programme: B.Tech. (ME)	**L:** 0 **T:** 0 **P:** 2
Semester: 3	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam(ESE):** 2hr
Total Marks: 50	**Course Status:** Compulsory

Prerequisites: Nil

On completion of the course, the student will have the ability to:

CO#	Course Outcomes(CO)
1	Conduct mechanical testing (Tensile, compression, Impact, bending, torsion of various materials).
2	Compare mechanical properties of various materials.
3	Analyse buckling load of long columns.
4	Understand load –deflection relation of helical spring.
5	Conduct fatigue testing of the materials.
6	Conduct hardness test on various materials.

Sr.No.	Name of Practical
1.	To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2.	To perform compression test and impact tests on the given specimen
3.	To perform hardness test. (Aluminium, Mild steel and Hardened steel)
4.	To perform torsion test and to determine various mechanical properties of the given material
5.	To perform bending test on beam and to determine the Young's modulus and modulus of rupture
6.	To determine buckling load of long columns with different end conditions.
7.	To draw load/ defection curve for helical spring
8.	To perform Fatigue test on circular test piece.

Reference Material

Manuals available in Lab.

Subject Code: LPCME-102 Subject Name: Engineering Materials and Metallurgy Laboratory

Programme: B.Tech. (ME)	**L:** 0 **T:** 0 **P:**2
Semester: 3	**Teaching Hours:** 20
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam(ESE):** 1 hr
Total Marks: 50	**Course Status:** Compulsory

Prerequisites: Knowledge of Engineering Metallurgy and Heat treatment.

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes(CO)
1	Identify various Crystal structures of different samples.
2	Compare various micro structures from standard specimens and compare with standard specimen.
3	Create/Prepare specimens of mild steel for study of microstructure.
4	Perform various Heat Treatment Processes practically on Specimens.
5	Determine the effect of various Quenching media on properties of steel.
6	Use different methods to determine Hardenability of steel specimens.

Special Instruction related to resources requirement: Instruments should be used under guidance of Lab Technician or Teacher.

Sr.No.	Name of Practical
1.	Preparation of models/Charts related to Atomic /Crystal Structures of Metals.
2.	To prepare specimen involving cutting, mounting, polishing and etching of Mild Steel and to study microstructure of prepared specimen.
3.	To study the microstructure of following materials from standard specimens. 1) Hypo eutectoid and hyper eutectoid steel. 2)White and Grey Cast Iron 3) Non Ferrous Metals: Brass, Copper 4) Heat Treated Specimens: Annealed, Normalized Hardened
4.	To conduct Normalizing on Steel specimen and to study the effect of Normalizing on Hardness and Microstructure
5.	To conduct Hardening of Steel specimen and to study the effect of Hardening on Hardness and Microstructure.
6.	To determine the effect of different quenching media (Water, Oil, Brine solution) on Hardness of Steel Specimen.
7.	To determine Hardenability of steel by Jominy End Quench test.

Reference Material

Manuals available in Lab.

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Subject Code: LPCME-103 **Subject Name: Manufacturing Processes Laboratory**

Programme: B.Tech. (ME)	**L:** 0 **T:** 0 **P:**2
Semester: 3	**Teaching Hours:** 20
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam(ESE):** 1 hr
Total Marks: 50	**Course Status:** Compulsory

Prerequisites: Manufacturing Practices

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes(CO)
1	Conduct various tests on molding sand
2	Determine major characteristics of molding sand.
3	Use the equipments like TIG MIG, welding and study the effect of various process parameters on weld quality.
4	Learn about grinding practice of single and multipoint cutting tools for efficient use of grinding equipment.
5	Use conventional cutting machine tools like milling for given jobs /work pieces.
6	Determine cutting forces with the use of tool dynamometer.

Special Instruction related to resources requirement: Instruments should be used under guidance of Lab Technician or Teacher.

Sr.No.	Name of Practical
1.	To determine grain fineness number, clay content and moisture content of a given sample of moulding sand.
2.	To Prepare a specimen of moulding sand on a standard Rammer and to carry out following tests: a) Tensile, compressive and transverse strength b)Mould Hardness c) Shatter index d)Permeability
3.	To study the effect of process parameters of MIG Welding (Voltage, wire feed, gas flow) on welding of Mild steel sheet.
4.	To study the effect of process parameters of TIG welding (Pulse, Gas flow, current) on welding of Stainless steel and Mild steel sheets.
5.	To grind single point and multipoint cutting tools and to prepare introductory report on cutting inserts.
6.	To determine cutting forces with dynamometer for turning operation.
7.	To prepare a job of spur gears by the use of milling machines.

Reference Material

Manuals available in Lab.

Subject Code: PCME-106 **Subject Name: Theory of Machines**

Programme: B.Tech.(ME)	**L:** 3 **T:** 1 **P:** 0
Semester: 4	**Teaching Hours:** 40
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 70%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites:

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Understanding the basic concept of kinematics and kinetics of machine elements.
2	Evaluate forces and couples applied to the machine elements.
3	Understand the function and application of gears and Evaluate the velocity ratio and torque in different gear trains.
4	Creating and designing of different types of cams.
5	Applying the concept of Static and dynamic balancing of rotating and reciprocating masses.
6	Understand the function of belt drives, brakes and clutches.

Detailed Contents:

Part-A

1. **Basic Concept of machines**: Degree of Freedom, Link, Mechanism, Kinematic Pair and Kinematic Chain, Principles of Inversion, Inversion of a Four Bar Chain, Slider-Crank-Chain and Double Slider-Crank-Chain. Grashoff's criterion, Graphical and Analytical methods for finding: Displacement, Velocity, and Acceleration of mechanisms (including Corliolis Components). **05Hrs**
2. **Force analysis**: Introduction, Concept of force and couple, free body diagram, condition of equilibrium, Static equilibrium of mechanisms, methods of static force analysis of simple mechanisms. **05 Hrs**
3. **Gears and Gear Trains**: Toothed gears and their applications, types of toothed gears and its terminology. Conditions for correct gearing, forms of teeth, length of Path of contact, length of arc of contact, contact ratio, involutes and its variants, interference and methods of its removal. Calculation of minimum number of teeth required on pinion and wheel for helical, spiral, bevel, worm gears and involute rack. Center distance for spiral gears and efficiency of spiral gears. Gear Trains: Types of gear trains such as simple, compound and epicyclic. **09Hrs**

Part-B

4. **Friction Devices:** Concepts of friction and wear related to bearing and clutches. Types of brakes function of brakes. Belt and Rope Drives : Flat and V-belts, Rope , Idle Pulley, Intermediate or Counter Shaft Pulley, Velocity Ratio, Crowning of Pulley, Loose and fast

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pulley, stepped or cone pulleys, ratio of tension on tight and slack side of belts, Length of belt, Power transmitted by belts including consideration of Creep and Slip. **06Hrs**

5. **Cams**: Types of cams and follower, definitions of terms connected with cams. Displacement, velocity and acceleration diagrams for cam followers. Analytical and Graphical design of cam profiles with various motions (SHM, uniform velocity, uniform acceleration and retardation, cycloidal Motion).Analysis of follower motion for circular, convex and tangent cam profiles **06 Hrs**
6. **Balancing**: Necessity of balancing, static and dynamic balancing, balancing of single and multiple rotating masses, partial unbalanced primary force in an engine, balancing of reciprocating masses, partial balancing of locomotives, swaying couple, variation of tractive effort and hammer blow condition of balance in multi cylinder in line and V-engines, concept of direct and reverse crank, balancing of machines, rotors and reversible rotors, two plane balancing of rotor **08 Hrs**

Text Books

1. S.S. Rattan, *"Theory of Machines"*, Mc Graw Hill Publications, 4th Edition, 2014.
2. Sadhu Singh, *"Theory of Machines"*, Pearson Education, 2nd Edition, 2009.
3. Thomas Bevan, *"Theory of Machines"*, CBS Publishers & Distributors, 3rd Edition 2005.
4. Robert L. Norton, *"Kinematics and Dynamics of Machinery"*, Tata McGraw-Hill, 1st Edition 2009.
5. Ghosh A. and Mallick A.K., *"Theory of Mechanisms and Machines"*, Affiliated East West Pvt. Ltd, New Delhi, 3rd Edition 1988.

Reference Books

1. Joesph E. Shigley, *"Theory of Machines"*, Tata McGraw Hill Publications, 2nd Edition, 2011
2. V.P. Singh, *"Theory of Machines"*, Dhanpat Rai and Sons Publications, 2nd Edition, 2004.
3. W.L Cleghorn. , *"Mechanisms of Machines"*, Oxford University Press, CDR Edition, 2005.

Topics for Self Learning (TSL)
1. Inertia forces and couples in machine parts.
2. Different types of brakes such as ABS and EBD and their applications.
3. Applications of Compound epicyclic gear trains.
4. Function of Governors and Flywheels.

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Subject Code: PCME-107 **Subject Name: Applied Thermodynamics**

Programme: B.Tech.(ME)	**L:** 3 **T:** 1 **P:** 0
Semester: 4	**Teaching Hours:** 39
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 50%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites:

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Understand various types of steam turbines and analyze various performance parameters.
2	Estimate the amount of cooling water required in a specific type of condenser.
3	Understand working principles and performance parameters of reciprocating and rotary compressors.
4	Understand working principles and performance parameters of Centrifugal and axial flow compressors.
5	Conduct thermal analysis of various types of gas turbines and their performance investigation.
6	Understand various types of jet propulsion systems and common propellants.

Detailed Contents:

PART-A

1. **Steam Turbines:** Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, state point locus, Losses in steam turbines, Governing of turbines, Comparison with steam engine. **04 Hrs**
2. **Steam Condensers:** Function of steam condensers, Elements of condensing unit, Types of condensers, Dalton's law of partial pressures applied to the condenser problems, Condenser and vacuum efficiencies, Cooling water calculations, Effect of air leakage, Method to check and prevent air infiltration, Description of air pump and calculation of its capacity, cooling towers: function, types and their operation. **04 Hrs**
3. **Reciprocating and rotary compressors:** Introduction, Classification of Air Compressors; Application of compressors and use of compressed air in industry and other places Single stage single acting reciprocating compressor (with and without clearance volume): construction, operation, work input and best value of index of compression, heat rejected to cooling medium, isothermal, overall thermal, isentropic, polytrophic, mechanical efficiency, Clearance Volumetric efficiency, Overall volumetric efficiency, effect of various parameters on volumetric efficiency, free air delivery; Multistage compressors: purpose and advantages, construction and operation, work input, heat rejected in intercoolers, minimum work input, optimum pressure ratio; isothermal, overall thermal, isentropic, polytropic and mechanical

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efficiencies Comparison of rotary positive displacement compressors with reciprocating compressors, like Roots blower, Lysholm compressor and Vane type Blower. **07 Hrs**

Part-B

4. **Centrifugal & Axial Flow Compressors:** Complete thermodynamic analysis of centrifugal compressor stage; Polytrophic, isentropic and isothermal efficiencies, Pre-guide vanes and pre-whirl; Slip factor, Degree of Reaction and its derivation; Energy transfer in backward, forward and radial vanes; Pressure coefficient as a function of slip factor, Surging and choking in compressors, Different components of axial flow compressor and their arrangement; Discussion on flow passages and simple theory of aero-foil blading; Angle of attack; coefficients of lift and drag; Turbine versus compressor blades; Velocity vector; Vector diagrams; Thermodynamic analysis; Work done on the compressor and power calculations, Comparison of axial flow compressor with centrifugal compressor and reaction turbine; Field of application of axial flow compressors. **08 Hrs**
5. **Gas Turbines**: Classification and comparison of the Open and Closed cycles; Classification on the basis of combustion (at constant volume or constant pressure); Comparison of gas turbine with a steam turbine and IC engine; Fields of application of gas turbines; Position of gas turbine in power industry; Thermodynamics of constant pressure gas turbine cycle (Brayton cycle); Calculation of net output, work ratio and thermal efficiency of ideal and actual cycles; Cycle air rate, temperature ratio; Effect of changes in specific heat and that of mass of fuel on power and efficiency; Operating variables and their effects on thermal efficiency and work ratio; Thermal refinements like regeneration, inter-cooling and re-heating and their different combinations in the gas turbine cycle and their effects on gas turbine cycle, Multistage compression and expansion; Dual Turbine system; Series and parallel arrangements; Closed and Semi-closed gas turbine cycle; Requirements of a gas turbine combustion chamber; Blade materials. Gas turbine fuels. **08 Hrs**
6. **Jet Propulsion:** Principle of jet propulsion; Description of different types of jet propulsion systems like rockets and thermal jet engines, like (i) Athodyd (ramjet and pulsejet), (ii) Turbojet engine, and (iii) Turboprop engine. Thermodynamics of turbojet engine components; Development of thrust and methods for its boosting/augmentation; Thrust work and thrust power; Propulsion energy, Propulsion and thermal (internal) efficiencies; Overall thermal efficiency; Specific fuel consumption; Rocket propulsion, its thrust and thrust power; Propulsion and overall thermal efficiency; Types of rocket motors (e.g. solid propellant and liquid propellant systems); Various common propellant combinations (i.e. fuels) used in rocket motors; Cooling of rockets; Advantages and disadvantages of jet propulsion over other propulsion systems; Brief introduction to performance characteristics of different propulsion systems; Fields of application of various propulsion units. **08 Hrs**

Text Books:

1. R. Yadav, *"Thermodynamics & Heat Engines"*, Central Publication House-Allahabad, 2011.
2. D. S. Kumar and V. P. Vasandani, *"Heat Engineering"*, S.K. Kataria & Sons; Reprint, 2013.

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3. J. S. Rajadurai , "*Thermodynamics and Thermal Engineering*" New Age International (P) Ltd. Publishers, 1st Edition 2003, Reprint 2015.
4. S.M. Yahya, *"Turbines, Compressors and Fans"*, McGraw Hill Education (India), Chennai,4th Edition,2017.
5. P. L. Ballaney, *" Thermal Engineering"*, Khanna Publishers, New Delhi, 2005.

Reference Books:

1. Jack D. Mattingly, *"Elements of Gas Turbine Propulsion"*, McGraw Hill Education (India), Chennai, 6th Edition, 2013.
2. H. Cohen, G. F. C. Rogers and M. Sarvan, *"Gas Turbine Theory"*, Pearson Education Canada; 5th Edition, 2008.
3. Heinz P. Bloch, *"Steam Turbines: Design, Applications, and Rerating"*, McGraw-Hill Professional, 2nd Edition, 2009. (E-Book available)

Topics for Self Learning (TSL)
1. ***Air Compressors:*** *Applications of various compressors according to working.*
2. ***Reciprocating Air Compressors****: Study of lubricants that can be used for cooling medium.*
3. ***Rotary compressors:*** *Troubleshooting in air compression.*
4. ***Steam Turbines****: Corrosion and erosion of steam turbine blades and its remedies.*
5. ***Gas Turbines****: Causes for Failure of gas turbine blades.*

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Subject Code: BSME-101 **Subject Name: Mathematics III**

Programme:B.Tech. (ME)	**L:** 3 T: 1 P: 0
Semester:4	**Teaching Hours:** 40
Theory/Practical: Theory	**Credits:**4
Internal Marks:40	**Percentage of Numerical/Design/Programming Problems:**90%
External Marks:60	**Duration of End Semester Exam (ESE):** 3hr
Total Marks:100	**Course Status:** Compulsory

Prerequisites: Knowledge of partial differentiation, probability and statistics.
Additional material allowed in ESE: Scientific calculator, log tables, probability distribution tables, statistical tables, etc.
On completion of the course, student will have the ability to:

CO#	Course Outcome (CO)
1.	Understand Partial Differential Equations and their solutions techniques.
2.	Infer the solution of several engineering problems involving one dimensional wave and heat equation , Laplace equation
3.	Evaluate the derivative and integration of functions of complex variable.
4.	Analyze probability spaces, random variables and bivariate distributions.
5.	Formulate and solve problems involving random variables.
6.	Apply statistical methods for analyzing experimental data.

Detailed Content:

Part-A

1. **Partial Differential Equations and Applications:** First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification. Solution of the wave equation, heat equation and Laplace equation solutions using separation of variables. **12 Hrs**
2. **Probability Distributions:** Probability spaces, conditional probability, independence; Discrete random variables, Poisson and binomial distribution. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule. **08Hrs**

Part-B

3. **Complex Variables**: Cauchy-Riemann equations, analytic functions, elementary analytic functions (exponential, trigonometric, logarithm) and their properties, harmonic functions, finding harmonic conjugate. Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof) Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine. Conformal mappings, Mobius transformations and their properties. **12 Hrs**
4. **Statistics**: Measures of Central tendency: Moments, skewness and Correlation and regression – Rank correlation. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Small sample test for single mean and difference of means, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes. **08Hrs**

Textbooks:

1. Erwin Kreyszig, *"Advanced Engineering Mathematics"*, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, *"A text book of Engineering Mathematics"*, Laxmi Publications, Re-print, 2010.
3. B.S. Grewal, *"Higher Engineering Mathematics"*, Khanna Publishers, 36th Edition, 2010.
4. B.V Ramana., *"Higher Engineering Mathematics"*, Tata McGraw Hill, 11th Reprint, 2010.

Reference books:

1. P. G. Hoel, S. C. Port and C. J. Stone, *"Introduction to Probability Theory"*, Universal Book Stall, 2003 (Reprint).
2. S. Ross, *"A First Course in Probability"*, Pearson Education India, 6th Edition, 2002.
3. J. W. Brown and R. V. Churchill, *"Complex Variables and Applications"*, Mc-Graw Hill, 7th Edition, 2004.
4. G.B. Thomas and R.L. Finney, *"Calculus and Analytic geometry"*, Pearson, Reprint, 9th Edition,2002.

Subject Code: PCME-108 **Subject Name: Fluid Mechanics and Machinery**

Programme: B.Tech.(ME)	**L:** 3 **T:** 1 **P:** 0
Semester: 4	**Teaching Hours:** 40
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 50%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites:

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, student will have the ability to:

CO#	Course Outcomes (CO)
1	Understand the structure and properties of the fluid.
2	Understand the concept and solve problems related to statics, kinematics and dynamics of fluids.
3	Use and apply dimensional analysis techniques to various physical fluid phenomena.
4	Analyze the viscous flow through pipe flow and determine head loss in pipe network.
5	Recognize basic components of turbo machines and understand related fundamental laws/ principles and apply these for calculation of various parameters like work done, force efficiency etc.
6	Understand constructional details, working and design aspects of runner/wheel and evaluate the performance of various turbines like Pelton, Francis, Kaplan, Centrifugal and Reciprocating pump.

Detailed Contents:

PART-A

1. **Basic Concepts and Properties:** Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges. **06 Hrs**
2. **Fluid Kinematics and Fluid Dynamics:** Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net – fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturimeter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's theorem- applications - similarity laws and models. **09 Hrs**

PART-B

3. **Incompressible Fluid Flow:** Viscous flow - Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen poiseulle's)- Hydraulic and energy gradient - flow through pipes - Darcy - weisback's equation - pipe roughness -friction factor - Moody's

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diagram-minor losses - flow through pipes in series and in parallel - power transmission - Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients. **10 Hrs**

4. **Hydraulic Turbines**: Euler's equation for turbo machines - Construction of velocity vector diagram's - head and specific work - components of energy transfer - degree of reaction. Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies -performance curve for turbines. **10 Hrs**
5. **Hydraulic Pumps:** Pumps: definition and classifications - Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principles, indicator diagram and work saved by air vessels and performance curves - cavitations in pumps. **05 Hrs**

TEXT BOOKS

1. D. S. Kumar, *"Fluid Mechanics and Fluid Power Engineering"*, S K Kataria and Sons, 2016.
2. F.M. White, *"Fluid Mechanics"*, Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
3. Jagdish Lal, *"Hydraulic Machines"*, Metropolitan Book Co. Pvt Ltd.-New Delhi; 6th Edition, 2016.
4. Y.A. Cengel and J.M. Cimbala, *"Fluid Mechanics - Fundamentals and Applications"*, Tata McGraw Hill Publications, 3rd Edition, 2013
5. S. K. Som, and G. Biswas, *"Introduction to Fluid Mechanics and Fluid Machines"*, Tata McGraw-Hill, 2nd Edition, 2004.

Reference Books

1. V.L. Streeter, and E. B. Wylie, *"Fluid Mechanics"*, McGraw-Hill, 1983.
2. I.G. Curie, *"Fundamentals of Fluid Mechanics"*, CRC Press; 4th Edition, 2016.
3. Mahmoud Galal El-Din Mohamed Rabi, *"Fluid Power Engineering"*, McGraw-Hill Professional,2009,(E-Book Available)

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Subject Code: PCME-109 **Subject Name: Modern Manufacturing Processes**

Programme: B.Tech.(ME)	**L:** 3 **T:** 0 **P:** 0
Semester: 4	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 10%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hr
Total Marks: 100	**Course Status:** Compulsory

Prerequisites: Manufacturing Technology
Additional Material Allowed in ESE: [Scientific Calculator]
On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Understand the concept of latest technologies and Non Traditional machining processes needed for manufacturing of components.
2	Select suitable technology or process for stringent requirement of manufacturing industry.
3	Describe and demonstrate the constructional features of machines/set ups related to major nonconventional machining.
4	Analyze the effect of process parameters on performance of major non-conventional machining.
5	Understand the concepts related to hybridization of modern machining processes and their utilization in industry.
6	Use various additive manifesting processes according to industrial requirements.

Detailed Contents:

Part – A

1. **Introduction:** Latest trends in Manufacturing; Introduction to Flexible manufacturing system; Introduction to computer integrated manufacturing; Development of Non-conventional manufacturing processes. **04Hrs**
2. **Modern Manufacturing Processes:** Modern Machining Processes: Mechanical Processes: Basics of Ultrasonic machining, Water Jet Machining and Abrasive Flow Machining; Applications and limitations. Electrochemical & Chemical Removal Processes: Principle of operation; elements and applications of Electrochemical Machining; Electro-chemical grinding; Electro-chemical honing; chemical machining. Thermal Metal Removal Processes: Electric Discharge Machining- Mechanism of metal removal; electrode feed control; selection of electrode material; applications. Plasma Arc Machining- Mechanism of metal removal; PAM parameters and applications. Laser Beam machining- Material removal; limitations and advantages. Electron-Beam Machining-; Generation and control of electron beam; process capabilities and limitations. Hybrid Machining Processes: Concept; classification; application; Advantages. **14 Hrs**

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Part - B

3. **Modern Welding Processes:** Principle, Equipment and Constructional details: Electron Beam Welding, Laser Beam Welding, Ion Beam Welding, Plasma welding, Thermit Welding, Electro slag and Electro gas Welding. Ultrasonic welding; Cold Metal Transfer technology; Friction stir Welding; Regulated Metal Deposition Process; Adhesive Bonding; Additive Manufacturing by welding. **07 Hrs**
4. **Modern casting Processes:** Evaporative Casting Process, investment, Shell Mold Casting, ceramic shell mould Vacuum molding, hot box, cold box casting process, full mould process, die casting, centrifugal casting. **05 Hrs**
5. **Modern Forming Processes:** High Energy Rate Forming Methods (HERF) Comparative Study of Conventional and High Velocity Forming of Metals, Review of Theory of plasticity, Principle, Process Parameters, equipment & mechanics of explosive forming, electro-hydraulic forming, magnetic pulse forming, Application of HERF Techniques. **05 Hrs**
6. **Additive manufacturing:** Introduction, advantages, limitations, and applications; Methods of producing metal powders, briquetting and sintering; Introduction to Selective Laser Melting and Selective Laser Sintering; 3-D Printing; Rapid prototyping and rapid tooling. **05Hrs**

Text Books:

1. P. C Panday ,H. S. Shan, "*Modern Machining Processes*", Tata McGraw Hill , 33rd Reprint , 2008.
2. Amitabha Ghosh and Asok Kumar Malik, "Manufacturing Science", Pearson Publications, 2nd Edition, 2010.
3. Serope Kalpakjian and Steven R. Schmid, *"Manufacturing Engineering and Technology"*, Pearson Publishers, 4th Edition, 2002.
4. V.K. Jain, "*Advanced Machining Processes*", Allied Publishers, 1stEdition, 2007.
5. Abdel Hassan, El-Hofy Gawad, "*Fundamentals of Machining Processes: Conventional and Nonconventional Processes*", Taylor& Francis, 2014.

Reference Books:

1. Amithaba Bhattacharyya, *"New Technology"*, The Institution Of Engineers, India
2. HMT Bangalore, *"Production Technology"*, Tata McGraw–Hill Publishing Company Limited, New Delhi, 2006.

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Subject Code: LPCME-104 **Subject Name: Theory of Machines Laboratory**

Programme: B.Tech. (ME)	**L:** 0 **T:** 0 **P:** 2
Semester: 4	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam(ESE):** 2hr
Total Marks: 50	**Course Status:** Compulsory

Prerequisites: Nil

On completion of the course, the student will have the ability to:

CO#	Course Outcomes(CO)
1	Conceptualize the function and applications of kinematic chains, mechanisms.
2	Calculate coefficient of friction for different types of belt-pulleys and material combinations.
3	Understand the function of gears and evaluate gear train value of different gear trains.
4	Determine magnitude and position of balancing mass for unbalanced rotating parts.
5	Create the profile of cam with various followers and pressure distribution profile of journal bearings.
6	Compare the function of governors and flywheels to control the engine speed.

Special Instruction related to resources requirement: Nil

Sr.No.	Name of Practical
1.	To fabricate various inversions of the kinematic chains.
2.	To draw displacement, velocity & acceleration diagrams of single slider/double slider crank & four bar mechanism by using working models.
3.	To determine coefficient of friction for a belt pulley material combination.
4.	To demonstrate various types of gears.
5.	To perform the balancing of rotating masses.
6.	To analyse the profile of a cam with various followers.
7.	To determine gear train value of compound gear trains & epicyclic gear trains.
8.	To draw circumferential & axial pressure profile of journal bearing.
9.	To conduct experiments on various types of governors & to co-relate equilibrium height & speed of the governor.
10.	To determine moment of inertia of a fly wheel.

Reference Material

Manuals available in Lab.

Subject Code: LPCME-105 **Subject Name: Applied Thermodynamics Laboratory**

Programme: B.Tech. (ME)	**L:** 0 **T:** 0 **P:** 2
Semester: 4	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam(ESE):** 1hr
Total Marks: 50	**Course Status:** Compulsory

Prerequisites: Thermodynamics

On completion of the course, the student will have the ability to:

CO#	Course Outcomes(CO)
1	Identify different types of IC engines and their parts; understand construction & working of IC engines.
2	Understand impact of valve timing on performance of IC engines.
3	Demonstrate the construction and working of different types of steam generators and their parts.
4	Evaluate the performance of steam generators.
5	Evaluate the performance of IC engines.
6	Demonstrate the construction and working of power plant parts like condensers.

Sr.No	Name of Practical
1.	Study of construction and operation of 2 stroke and 4 stroke Petrol and Diesel engines using actual engines or models.
2.	To plot actual valve timing diagram of a 4 stroke petrol and diesel engines and study its impact on the performance of engine.
3.	Study working construction of various boilers (Cochran, Lancashire, Babcock and Wilcox, Benson, Lamont, once through boiler tower type).
4.	Study of working, construction, mountings and accessories of various types of boilers.
5.	To perform a boiler trial to estimate equivalent evaporation and efficiency of a fire tube/ water tube boiler.
6.	Determination of dryness fraction of steam and estimation of brake power, Rankine efficiency, relative efficiency, generator efficiency, and overall efficiency of an impulse steam turbine and to plot a Willian's line.
7.	Determine the brake power, indicated power, friction power and mechanical efficiency of a multi cylinder petrol engine running at constant speed (Morse Test).
8.	Performance testing of a diesel engine from no load to full load (at constant speed) for a single cylinder/ multi-cylinder engine in terms of brake power, indicated power, mechanical efficiency and specific fuel consumption and to measure the smoke density. Draw/obtain power consumption and exhaust emission curves. Also, make the heat balance sheet.
9.	Performance testing of a petrol engine from no load to full load (at constant speed) for a single cylinder/ multi-cylinder engine in terms of brake power, indicated power, mechanical efficiency and specific fuel consumption and to measure the exhaust emissions. Also, draw/obtain power consumption and exhaust emission curves.
10.	Study of construction and operation of various types of steam condensers and cooling towers.

Reference Material:

Manuals available in Lab.

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Subject Code: LPCME-106 Subject Name: Fluid Mechanics & Machinery Laboratory

Programme: B.Tech. (ME)	**L:** 0 **T:** 0 **P:** 2
Semester: 4	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam(ESE):** 1hr
Total Marks: 50	**Course Status:** Compulsory

Prerequisites:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes(CO)
1	Understand different concept of continuity equation and flow rate.
2	Analyze different form of energies in fluid flow and inter conversion.
3	Distinguish various types of flows and flow measurement methods.
4	Calculate the head losses associated with friction and pipe fittings
5	Suggest installations of hydraulic turbine depending on different requirements.
6	Understand working of various types of pumps and remedial solutions for different faults.

Sr.No.	Name of Practical
1.	To determine the meta-centric height of a floating vessel under loaded and unloaded conditions.
2.	To study the flow through a variable area duct and verify Bernoulli's energy equation.
3.	To determine the discharge coefficient for a venturi meter.
4.	To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.
5.	To determine the discharge coefficient for a V- notch or rectangular notch.
6.	To determine the friction coefficients for pipes of different diameters.
7.	To draw performance /characteristics curves of Pelton turbine/ Francis Turbine.
8.	To draw performance/ characteristics curves of Centrifugal pump/reciprocating pump.

Reference Material

Manuals available in Lab.

Subject Code: LPCME-107 Subject Name: Modern Manufacturing Process Laboratory

Programme: B.Tech. (ME)	**L:** 0 **T:** 0 **P:** 2
Semester: 4	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:** 100%
External Marks: 20	**Duration of End Semester Exam(ESE):** 1hr
Total Marks: 50	**Course Status:** Compulsory

Prerequisites:

On completion of the course, the student will have the ability to:

CO#	Course Outcomes(CO)
1	Understand the concepts of CNC machine tools, their types and features
2	Generate part programs using CNC programming and simulation.
3	Evaluate the performance of drilling by CNC drill machine.
4	Understand the concept of additive manufacturing.
5	Understand the performance of EDM.
6	Evaluate the performance of electrochemical machine.

Sr.No.	Name of Practical
1.	Study the characteristics of various CNC machines on swansoft simulator.
2.	Machining practice on CNC milling trainer
3.	Practice on single axis CNC Drilling machine.
4.	Study the performance characteristics of electrical discharge machining process
5.	Demonstration the working of 3D Printer machine.
6.	Machining practice on electrochemical machine.

Reference Material

Manuals available in Lab.