UNIVERSITY OF JAMMU

NOTIFICATION

(19/Aug/Adp/30)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Competent Bodies, has been pleased to authorize the adoption of revised Syllabus of **Bachelor of Engineering (Mechanical Engineering)** for Semester III & IV under the **Choice Based Credit System** as per the model curriculum of the **AICTE (as given in the Annexure)** for the candidates of **all (Govt./Pvt./UIET) Engineering Colleges affiliated with the University of Jammu** for the Examinations to be held in the years indicated against each Semester as under :-

Branch	Semester	For the Examination to be held in the years
Mechanical	**Semester-III**	**December 2019, 2020, 2021 and 2022**
	Semester-IV	**May 2020, 2021, 2022 and 2023**

The Syllabi of the course is available on the University Website: *www.jammuuniversity.in.*

Sd/-
DEAN ACADEMIC AFFAIRS

No. F.Acd/III/19/4780-4792
Dated:20/08/2019
Copy for information & necessary action to:-

1. Dean Faculty of Engineering
2. Principal, GCET/MIET/MBSCET/UIET/BCET/YCET
3. C.A to the Controller of Examinations
4. Assistant Registrar (Exams/Confidential)
5. Section Officer (Confidential)
6. Incharge University Website

Assistant Registrar (Academics)

19/8 19/8 19/08/19

ANNEXURE I

B.E. Mechanical Engineering 3rd Semester Examination to be held in the Year December 2019,2020,2021,2022

B.E. Mechanical Engineering 3rd Semester **Contract Hrs.: 26**

COURSE CODE	COURSE TYPE	COURSE TITLE	LOAD ALLOCATIONS			MARKS DISTRIBUTION		TOTAL MARKS	CREDITS	% CHANGE
			L	T	P	INTERNAL	EXTERNAL			
PME-301	Professional Core Course	Fluid Mechanics	3	1	0	50	100	150	**4**	100%
PME-302	Professional Core Course	Thermodynamics	3	1	0	50	100	150	**4**	100%
PME-303	Professional Core Course	Machine Drawing	1	0	2	25	100	125	**2**	100%
PME-304	Professional Core Course	Mechanics Of Solids	3	1	0	50	100	150	**4**	100%
PME-305	Professional Core Course	Production Technology-I	2	1	0	50	100	150	**3**	100%
PME-311	Professional Core Course	Fluid Mechanics Lab.	0	0	2	75	0	75	**1**	100%
PME-312	Professional Core Course	Thermodynamics Lab.	0	0	2	75	0	75	**1**	100%
PME-313	Professional Core Course	Mechanics Of Solids Lab.	0	0	2	75	0	75	**1**	100%
PME-314	Professional Core Course	Workshop Practice 1	0	0	2	50	0	50	**1**	100%
TOTAL			**12**	**4**	**10**	**500**	**500**	**1000**	**21**	

3rd Semester Examination to be held in the YearDecember 2019,2020,2021,2022

CLASS:B.E.3rd SEMESTER **CREDITS: 4**
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: FLUID MECHANICS
COURSE NO.: PME-301
DURATION OF EXAMINATION: 3 HOURS.

			Marks	
L	**T**	**P**	**Theory**	**Sessional**
3	**1**	**0**	**100**	**50**

COURSE OUTCOMES **At the end of the course student will be able to:**	
CO301.1:	Determine the fluid flow as it is the main component which decides power associated with the fluid.
CO301.2:	Determined energy associated with fluid flow in a channel or a steam.
CO301.3:	Know the nature fluid in order to choose appropriate fluid as per need.
CO301.4:	Determine losses occurred when dealing with a fluid flowing in a channel.
CO301.5:	Determine friction factor from Darcy-Weisbach equation.

Detailed Syllabus

SECTION - A

Fluids and their properties, Fluids-shear stress in a moving fluid-difference between solids and fluids-viscosity - Newtonian and Non-Newtonian fluids - viscosity in liquids and gases - density-surface tension - capillarity. **[5 Hours]**

Fluid Statics: Pressureabsolute and gauge pressure- measurement of gauge pressure-centreof pressure - buoyancy and stability of submerged and floating bodies - metacentric heights. **[5 Hours]**

Kinematics of Fluid Flow: Eulerian&lagrangianapproaches, classification of fluid flow as steady and unsteady flow, uniform and non-uniform flow, laminar and turbulent flow - pathline, stream line, streak line and stream tube - one, two and three dimensional flow - velocity and acceleration in steady and unsteady flow. Basic hydrodynamics: ideal fluids - equation of continuity in the differential form .stream function. Euler's equation for unsteady flow in three dimensions - one dimensional flow along a stream of velocity, Bernoulli's equation and its applications - pitot and pitot-static tubes - venturimeter, flow nozzles. **[10 Hours]**

SECTION - B

Basic equations of Fluid Mechanics : equation of continuity, momentum equation and energy equation for a control volume, adoption of these equation to one dimensional flow - velocity and momentum correlation - application of momentum equation to straight and bent, uniform and reducing conduits, path of trajectory of a free liquid jet. **[10Hours]**

Steady flow of incompressible fluids in Pipes, Laminar and Turbulent flows, critical Reynold's number - hydraulic radius - general equation for friction, friction in non-circular pipes - Darcy Weisbach equation - development of boundary layer in pipe's flow, smooth and round pipes, Minor losses in pipes. **[10 Hours]**

RECOMMENDED BOOKS:

1. Fluid Mechanics — VL Streeter
2. Fluid Mechanics with Engineering Applications — Dougherty &Franzini
3. Engineering Fluid Mechanics — Roberson & Crowe
4. Fluid Mechanics — Massey
5. Fluid Mechanics — KL Kumar

NOTE:

1. Question paper will be of 3 Hours' duration.
2. There will be 8 questions in all, four from **Section- A** (each of 20 marks) and four from**Section– B**(each of 20 marks)**.**
3. Students are required to attempt five questions in all, atleast two questions from each section.
4. Use of scientific calculator will be allowed in the examination hall.

3rd Semester Examination to be held in the Year December 2019,2020,2021,2022

CLASS: B.E. 3rd SEMESTER **CREDITS: 4**
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: ENGG.THERMODYNAMICS
COURSE NO.: PME-302
DURATION OF EXAMINATION: 3 HOURS.

			Marks	
L	**T**	**P**	**Theory**	**Sessional**
3	**1**	**0**	**100**	**50**

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO302.1:	Apply fundamental concepts of thermodynamics to engineering applications.
CO302.2:	Estimate thermodynamic properties of substances in gas and liquid states..
CO302.3:	Determine thermodynamic efficiency of various energy related processes.
CO302.4:	Observe and distinguish the different thermodynamic processes around them and think creatively.
CO302.5:	Read data from various defined steam tables and psychometrics tables.

Detailed Syllabus

SECTION - A

Concept of work-first law of thermodynamics, concept of energy, definition of heat open system, concept of enthalpy, specific heats, steady flow energy equation and related applications.Second law of thermodynamics and applications, various statements and their equivalence, reversible process and reversible cycle, Carnot theorem, concept of thermodynamic temperature scale, Clausius theorem. **[5 Hours]**

Entropy ,Concept of entropy, calculations of change in entropy, reversibility and irreversibility, Clausius inequality, Law of increase in entropy of universe. Applications of entropy principle.Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- Heat calculations using enthalpy tables. **[10 Hours]**

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, energy analysis. Super-critical and ultra-super-critical Rankine cycle-Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle effect of reheat, regeneration and intercooling- **[5 Hours]**

SECTION - B

Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.
Properties of dry and wet air, use of psychometricchart, processes involving heating/cooling and humidification/dehumidification, dew point. **[10 Hours]**

Vapor compression refrigeration cycles, refrigerants and their properties.
Analysis of steam turbines,velocity and pressure compounding of steam turbines.
Reciprocating compressors, staging of reciprocating compressors, Optimal stage pressure ratio, effect of intercooling, Minimum work for multistage reciprocating compressors.
I.C engines & S.I engines. **[12 Hours]**

RECOMMENDED BOOKS:

1. Engineering Thermodynamics — R.K Rajput
2. A Course in Thermodynamics — Joseph Kestin
3. Heat and Thermodynamics — M.W. Zemansky

NOTE:

1. Question paper will be of 3 Hours' duration
2. There will be 8 questions in all, four from **Section- A** (each of 20 marks) and four from**Section – B**(each of 20 marks).
3. Students are required to attempt five questions in all, atleast two question from each section
4. Use of scientific calculator will be allowed in the examination hall.
5. Use of Steam tables, Mollier chart and scientific calculator will be allowed in the examination hall.

3rd Semester Examination to be held in the Year December 2019,2020,2021,2022

CLASS: B.E. 3rd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: MACHINE DRAWING
COURSE NO.: PME-303
DURATION OF EXAMINATION: 4 HOURS.

CREDITS: 2

L	T	P	Marks: Theory	Marks: Sessional
1	0	2	100	25

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO303.1:	Understand about design aspect
CO303.2:	Understand 2D and 3D views of assembly
CO303.3:	Draw different views of assembly.
CO303.4:	Draw disassembly from assembled view.
CO303.5:	Differentiate between different types of coupling, bearing and pulleys.

Detailed Syllabus

SECTION-A

1. Assembly Drawings of the following machines:
- a) Steam and I.C. Engines : Piston, Connecting Rod
- b) Machine tools : Tailstock, Machine vices.
- c) Boiler Mountings : Feed check valve, Steam stop valve, and Blow off Cock. **[10 Hours]**

2. Bearings: Pedestal bearing, Pivot bearing and Swivel bearing. **[10 Hours]**

SECTION- B

3. Simple assemblies: Shaft couplings, Muff Coupling, Split muff, Flange Couplings, Protected and Unprotected, Universal Coupling **[6 Hours]**

4. Construction of Profiles for(a)Spur Gear Teeth (Involute), (b)Cams **[6 Hours]**

5. Different types of Joints: Riveted joints, Threaded fasteners, Knuckle joint, Cotter Joints: Gib and Cotter. **[4 Hours]**

RECOMMENDED BOOKS:

1. Machine Drawing — P. S. Gill.
2. Machine Drawing — N. D. Bhat.
3. Machine Drawing — R. B. Gupta.

NOTE:

1. Question paper will be of 4 Hours' duration.
2. There will be Six questions in all, five from **Section- B** (each of 15 marks) and one Compulsory question of 55 marks from **Section - A.**
3. Students are required to attempt four questions in all, three form Section-B and one compulsory question involving assembly from **Section A.**
4. Use of scientific calculator will be allowed in the examination hall.

3rd Semester Examination to be held in the Year December 2019,2020,2021,2022

CLASS: B.E. 3rd SEMESTER
BRANCH: MECHANICAL ENGINEERING **CREDITS: 4**
COURSE TITLE: MECHANICS OF SOLIDS
COURSE NO.:PME-304
DURATION OF EXAMINATION: 3 HOURS.

			Marks	
L	**T**	**P**	**Theory**	**Sessional**
3	**1**	**0**	**100**	**50**

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO304.1:	Analyze problems related to mechanics of solid engineering bodies & Differentiate between principal stresses.
CO304.2:	Analyze and solve problems related to statically determinate and indeterminate beams.
CO304.3:	Describe and use of torsional effects on beams
CO304.4:	Understanding the effects of strain energy in beams
CO304.5:	Understand the mechanics behind the cylinder design.

Detailed Syllabus

SECTION - A.

Stresses and Strains: Stress and Strain, Stress – Strain Diagram, Material properties. Hooke's Law, Poisson's ratio, Transformation of stresses and strains (Two dimensional case only), Relation between elastic constants.Stresses in axially loaded members.Thermal stresses. Principal stresses, Mohr's circle of stress. **[10 Hours]**

Shear force and Bending moment diagrams. Bending of Beam**:**Normal and shear stresses in bending of beams. Torsion of circular sections, Torsion formula, Angle of twist, Shearing stresses. Combined Bending and Torsion.Columns&Struts **:**Theory, Buckling, Euler's formulae for different end conditions .

[10Hours]

SECTION - B.

Thick Cylinders: Lame's Theorem for determining the Principle Stress in a thick cylinder (Open ended and Ends Closed) under Internal and External Pressures, Strains and radial reflection. Curved Beams : Bending of curved bars, Determination of bending stress as through Winkler– Bach Solution, Radial Stresses, Location of Neutral axis, Thick Rings and Chain links. **[12 Hours]**

Statically Indeterminate Beams: Theorem of Three moments and applications. Theories of failure: Theories of failure as applicable to ductile and brittle materials, their significance and comparison. **[8 Hours]**

RECOMMENDED BOOKS:

1. Advanced Mechanics of Solids — L.S.Srinath
2. Elements of Strength of Materials — Timoshenko & Young
3. Mechanics of Material — Beer & Johnson
4. Mechanics of Solids — Popov
5. Strength of Materials — R.K Rajput

NOTE:

1. Question paper will be of 3 Hours' duration.
2. There will be 8 questions in all, four from **Section- A** (each of 20 marks) and four from **Section –B**(each of 20 marks)**.**
3. Students are required to attempt five questions in all, atleast two questions from each section
4. Use of scientific calculator will be allowed in the examination hall.

3rd Semester Examination to be held in the YearDecember 2019,2020,2021,2022

CLASS: B.E. 3rd SEMESTER
BRANCH: MECHANICAL ENGINEERING **CREDITS: 3**
COURSE TITLE:PRODUCTION TECHNOLOGY-I
COURSE NO.:PME-305 **Marks**

DURATION OF EXAMINATION: 3 HOURS.	**L**	**T**	**P**	**Theory**	**Sessional**
	2	**1**	**0**	**100**	**50**

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO305.1:	Recognize the different types of casting process.
CO305.2:	Select suitable manufacturing process for typical components.
CO305.3:	Describe the various welding process.
CO305.4:	Explain the concept of forging,rolling process and drawing.
CO305.5:	Explain various production technique used in various engineering communities.

Detailed Syllabus

SECTION - A

Introduction: Definition, primary and secondary processes, criteria for selection.
Casting: As a production process, patterns, allowances, design and layout.
Moulds: Types, materials, foundry sands, Properties of moulding materials, and testing cores, core making process, melting furnace, Cupola.
Gating and Risering: Types of gating systems, pouring time and temperature. Design criteria for pouring basin, sprue, runner gate and riser, problems on gating design, directional principle; Special casting processes: shell, investment, centrifugal, permanent mould castings and die castings, defects and inspection of castings. **[20 HOURS]**

SECTION - B

Mechanical, working processes: Plastic deformation, hot and cold working, forming processes. Rolling, drawing, deep drawing, extrusion,.Analysis of forces and pressure based on equilibrium equation in strip rolling, drawing and extrusion (simple cases)
Forging operation: Drop forging, press forging, die forging, sheet metal operations, punching, piercing operations.
Welding processes: Definition, classification, and selection.types of flames, gas cuttingArc welding, principle of arc welding, arc initiation, arc welding equipment, power sources and their selection, manual metal arc welding, submerged arc welding, shielded arc welding (TIG & MIG), resistance welding, soldering and brazing, welding inspection and defects. **[20 HOURS]**

NOTE:

1. Question paper will be of 3 Hours' duration
2. There will be 8 questions in all, four from **Section- A** (each of 20 marks) and four from**Section – B**(each of 20 marks)**.**
3. Students are required to attempt five questions in all, atleast two question from each section
4. Use of scientific calculator will be allowed in the examination hall.

3rd Semester Examination to be held in the YearDecember 2019,2020,2021,2022

CLASS: B.E. 3rd SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: FLUID MECHANICS LAB.
COURSE NO.: PME-311

CREDITS: 1

L	T	P	Marks Practical
0	0	2	75

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO311.1	Estimate the friction and measure the frictional losses in fluid flow.
CO311.2	Experiment with flow measurement devices like venturimeter and orifice meter.
CO311.3	Predict the coefficient of discharge for flow through pipes.

LIST OF EXPERIMENTS:

1. To find out the Metacentric Height of the floating pontoon.
2. To verify the Bernoulli's Equation.
3. To find out the co-efficient of discharge using Venturimeter.
4. To find out the co-efficient of discharge using Orificemeter.
5. To find out the co-efficient of discharge using Pitot tube.
6. To analyse the regimes of flow using Reynold's Experiment.
7. To find out the viscosity of a fluid using Redwood Viscometer.
8. To find out the Friction factor of a pipe and compare the resistances to flow in various pipes
9. To find out discharge through Notches.

NOTE:

1. Atleast six practical's should be performed.
2. Additional lab/ experiment will be performed based on course content requirement.
3. Simulation/ virtual labs are used to enhance the practical ability of students.

3rd Semester Examination to be held in the YearDecember 2019,2020,2021,2022

CLASS: B.E. 3RD SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: THERMODYNAMICS LAB
COURSE CODE: PME-312

CREDITS: 1

L	T	P	Marks Practical
0	0	2	75

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO312.1	Compute the property of real gases.
CO312.2	Demonstrate the performance of Refrigerator and Heat pump.
CO312.3	Interpret the characteristics of Boiler.

LIST OF EXPERIMENTS:

1. To verify Second law of thermodynamics with the help of heat engine.
2. To analyse the p-v-T behavior of real gases in comparison with Ideal gases.
3. To analyse steam boiler and its accessories and determination of:
   i) Equivalent Evaporation
   ii) The dryness fraction of steam using Throttling Calorimeter
4. To find out the COP of the Refrigerator.
5. To find out the COP of the Heat Pump.
6. To analyse isentropic flow of a perfect gas through a nozzle.
7. To find volumetric and isothermal efficiency of reciprocating air compressor.
8. To find COP of air conditioning unit.
9. To study and calculate the efficiency of Petrol engine.
10. To study and calculate the efficiency of Diesel engine.

NOTE:

1. Atleast six practical's should be performed.
2. Additional lab/ experiment will be performed based on course content requirement.

3rd Semester Examination to be held in the YearDecember 2019,2020,2021,2022

CLASS: B.E. 3RD SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: MECHANICS OF SOLID LAB.
COURSE NO.: PME-313

CREDITS: 1

L	T	P	Marks Practical
0	0	2	75

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO312.1	Describe the behavior of materials upon normal external loads.
CO312.2	Predict the behavior of the material under impact conditions.
CO312.3	Recognize the mechanical behavior of materials.

LIST OF EXPERIMENTS:

1. To conduct the tensile test on a M.S. specimen and draw the load extension diagram using a UTM.
2. To conduct the compression test on a concrete specimen and draw the load compression diagram using a UTM.
3. To conduct torsion test on mild steel or cast iron specimen to determine modulus of rigidity.
4. To find the hardness of a specimen using Rockwell Hardness Tester.
5. To find the hardness of a specimen using Brinell Hardness Tester.
6. To find the hardness of a specimen using Vickers Hardness Tester
7. To conduct the Izod and Charpy Tests on a notched M.S. specimen
8. To conduct simple bending experiments for different types of loading.

NOTE:

1. At least six practical's should be performed.
2. Additional lab/ experiment will be performed based on course content requirement.

ANNEXURE II

B.E. Mechanical Engineering 4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

B.E. Mechanical Engineering 4thSemester **Contract Hrs.: 25**

COURSE CODE	COURSE TYPE	COURSE TITLE	LOAD ALLOCATIONS			MARKS DISTRIBUTION		TOTAL MARKS	CREDITS	%CHANGE
			L	T	P	INTERNAL	EXTERNAL			
BSC-403	Basic Science Course	EnggMaths-III	2	1	0	50	100	150	**3**	50%
PME-401	Professional Core Course	Heat Transfer	3	1	0	50	100	150	**4**	100%
PME-402	Professional Core Course	Metallurgy & Material Science	2	1	0	50	100	150	**3**	100%
PME-403	Professional Core Course	Theory of M/c	3	1	0	50	100	150	**4**	100%
PME-404	Professional Core Course	Maintenance Engineering	2	1	0	50	100	150	**3**	100%
PME-411	Professional Core Course	Heat Transfer Lab	0	0	2	75	-	75	**1**	100%
PME-412	Professional Core Course	Metallurgy & Material Science Lab	0	0	2	50	-	50	**1**	100%
PME-413	Professional Core Course	Theory of M/c Lab	0	0	2	75	-	75	**1**	100%
PME-414	Professional Core Course	Maintenance Engineering Lab/Automotive Lab.	0	0	2	50	-	50	**1**	100%
MOC-415	Massive Open Online Course	MOOC	-	-	-	-	-	-	-	100%
TOTAL			**12**	**5**	**8**	**500**	**500**	**1000**	**21**	

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CLASS: B.E. 4thSEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: ENGG. MATHEMATICS III
COURSE NO.: BSC 403
DURATION OF EXAM: 3 HOURS

CREDITS: 3

L	T	P	Marks Theory	Marks Sessional
2	1	0	100	50

COURSE OUTCOMES At the end of the course student will be able to:	
CO403.1:	Understand the concept of limit,continuity and derivative of the complex functions
CO403.2:	To evaluate the various integrals using the concept of analyticfunctions.
CO403.3:	Understand the concept of random variables.
CO403.4:	To learn about the different distributions and their properties.

Detailed Syllabus

SECTION - A

Complex Variables:
Limits, Continuity, Derivatives, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.
[10 Hours]

Line Integral, Cauchy's theorem, Cauchy Integral formula, Liouville's theorem and Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem and Contour integral **[10 Hours]**

SECTION - B

Probability:
Discrete random variables, independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sum of independent random variables, Expectation of Discrete Random variables, Moments, Variance of a sum, Correlations coefficient. **[10 Hours]**
Continuous random variables and their properties, distribution functions and densities, Normal, exponential and gamma densities.Bayes' rule.
[10 Hours]

Text / References:

1. Dr.Bhopinder Singh,'' A textbook on complex variables and Numerical methods, Kirti Publishers.
2. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.
4. S. Ross,A First Course in Probability,6th Ed., Pearson Education India, 2002.

NOTE:

1. Question paper will be of 3 Hours' duration
2. There will be 8 questions in all, four from **Section- A** (each of 20 marks) and four from **Section – B** (each of 20 marks).
3. Students are required to attempt five questions in all, at least two question from each section.

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CLASS: B.E. 4TH SEMESTER **CREDITS: 4**
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: HEAT TRANSFER

COURSE NO: PME-401	L	T	P	Marks Theory	Marks Sessional
DURATION OF EXAMINATION: 3 HOURS	3	1	0	100	50

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO401.1:	Apply principles of heat and mass transfer to basic engineering systems.
CO401.2:	Analyse heat transfer by conduction, convection.
CO401.3:	Analyse and design heat exchangers
CO401.4:	Analyse diffusional process and calculate the flux in diffusion process.
CO401.5:	Analyse black body and its application.

Detailed Syllabus

SECTION - A

Introduction: Basic modes of heat transfer.
Conduction: General heat conduction equation in Cartesian and Cylindrical co-ordinates, One dimensional steady state conduction with and without heat generation, Critical insulation thickness, Extended surface heat transfer, Variable thermal conductivity. **[10 Hours]**
Convection: Newton's Law, Concept of boundary layer, Significance of Prandtlnumber , Boundary layer equations, Flat plate heat transfer solutions by integral method, Laminar and Turbulent flow of heat transfer in tubes.
Natural convection: Heat transfer from vertical plate by integral method, Empirical relations in free convection, Condensation and Boiling, Film and Dropwise condensation, Film boiling and pool boiling. **[10 Hours]**

SECTION - B

Radiation: Radiation spectrum, Thermal radiation, Concept of black body, Monochromatic emissive power, Absorptivity , Reflectivity, Transmissivity, Emissivity, Plank's Law, Stephan Boltzman's Law, Lambert's Law, Kirchoff'sLaw. Radiation between two real surfaces, Geometrical factors for simple configuration, Heat transfer in presence of re-radiating surfaces, Radiation shields. **[10 Hours]**
Heat exchangers: Types of heat exchangers, Log mean temperature difference, Overall heat transfer coefficient, Fouling and scaling of heat exchangers, N.T.U. method of evaluation of heat exchangers.Heat exchanger effectiveness. **[10 Hours]**

RECOMMENDED BOOKS:

1. Heat Transfer — J.P. Holman
2. Heat Transfer — Frank Krieth
3. Engineering Heat Transfer — Gupta and Prakash .
4. Fundamentals of Heat Transfer — Frank P. David P. Dewitt
5. Heat Transfer — B. Gebhart

NOTE:

1. Question paper will be of 3 Hours' duration
2. There will be 8 questions in all, four from **Section- A** (each of 20 marks) and four from**Section – B** (each of 20 marks).
3. Students are required to attempt five questions in all, atleast two question from each section.
4. Use of Heat Transfer data book and a scientific calculator will be allowed in the examination hall.

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CLASS: B.E. 4th SEMESTER **CREDITS: 3**
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: METALLURGY AND MATERIAL SCIENCE
COURSE NO.: PME-402
DURATION OF EXAMINATION: 3 HOURS.

			Marks	
L	**T**	**P**	**Theory**	**Sessional**
2	**1**	**0**	**100**	**50**

COURSE OUTCOMES **At the end of the course student will be able to:**	
CO402.1:	Analyse the structure of material at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF, Co-ordination number etc.
CO402.2:	Understand the concept of mechanical behavior of material and calculation of same appropriate equations.
CO402.3:	Explain the concept phase diagram and understand the basic technologies associated with the metallurgy. Construction and identification of phase diagram and reactions.
CO402.4:	Understand and suggest the heat treatment process and types .Significance of properties Vs microstructure. Surface hardening and its type. Introduce the concept of hardenability and demonstrate the test used to find hardenability of steels
CO402.5:	Explain features, classification, application of newer class material like smart materials, piezoelectric materials, biomaterials, composite materials etc.

Detailed Syllabus

SECTION - A

Crystal structure : Space Lattice, Crystal Systems, crystal directions and planes, Miller indices, Planar density of crystallographic planes, Interplaner spacing, Stacking sequence. Solidification of metals: Homogeneous and Heterogeneous nucleation, Crystal growth, Dendritic pattern. **Crystal Imperfections :** Point defect , Line defect, Edge dislocation, Screw dislocation, Interactions between dislocations, Planar defects, Stacking fault, Twinning, Grain boundary, Diffusion, Mechanism of diffusion in crystals, Fick's laws of diffusion. **[10 Hours]**

Phase: Equilibrium between phases, Gibb's phase rule, Solid solutions, Interstitial, Substitutional, Ordered and disordered types, Hume-Rothery rules. Equilibrium phase Diagrams of Binary Alloys: Construction from cooling curves, Phase diagram of Cu-Ni system, Lever rule, Coring, Eutectic alloyEutectic reaction, Partial solid solubility, Iron-Iron carbide diagram, Peritectic and Eutectoid reactions. **[10 Hours]**

SECTION - B

T-T-T-Diagram and its uses : Heat Treatment of Carbon steel, Annealing, Normalising, Hardening, Tampering, Austempering, Martempering, Hardenability, Case hardening, Surface treatment of steel, metallic coating, Electroplating, Metal facing and cladding. Failure of metals: Creep, Mechanism of creep, Creep curves, Creep resistance materials, Fracture, Brittle fracture, Griffith's theory, Ductile fracture. **[10 Hours]**

Deformation of metals : Elastic, Inelastic and visco elastic behaviour, Plastic deformation, Mechanism of slip, Slip planes and slip directions, Strengthening mechanisms, Work hardening, Grain boundary hardening, Precipitation hardening, Cold working, Hot working. **[10 Hours]**

RECOMMENDED BOOKS:

1. Science of Engineering (Vol. I, II & III) — ManasChanda
2. Elements of Material Science — LH Van Vlack
3. Physical Metallurgy Principles — Reed Hill

NOTE:

1. Question paper will be of 3 Hours' duration
2. There will be 8 questions in all, four from Section- A (each of 20 marks) and four fromSection - B.
3. Students are required to attempt five questions in all, atleast two question from each section
4. Use of scientific calculator will be allowed in the examination hall.

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CLASS: B.E. 4th SEMESTER **CREDITS: 4**
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: THEORY OF MACHINES
COURSE NO.: PME-403
DURATION OF EXAMINATION: 3 HOURS.

			Marks	
L	**T**	**P**	**Theory**	**Sessional**
3	**1**	**0**	**100**	**50**

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO403.1:	Be familiar with common machine elements and Analysis of different mechanisms used in various types of machines.
CO403.2:	Be familiar with concepts of gears, cams, governors. Be aware of common machine elements & to solve problems related to motion transmission
CO403.3:	Dynamically analyze common mechanisms.
CO403.4:	Conceptualize gyroscopic effect& Mathematically solve problems of flywheel.
CO403.5:	Conceptualize static and dynamic balancing of rotating and reciprocating& Identify various types of mechanical vibrations, their causes and solutions

Detailed Syllabus

SECTION - A

Mechanisms and machines, plane mechanisms, kinematic pairs, kinematic chains and their classification, kinematic inversion. Introduction, general case of plane motion, velocity, acceleration, velocity and acceleration images, velocity analysis using instantaneous centres(Graphical method only). Cams**:** Classification of cams and followers, geometry of radial cam, displacement diagram, uniform, simple harmonic, graphical layout of cam profiles with different followers, follower velocity. **[10 Hours]**

Governors:Purpose, comparison with flywheel, Porter, Proell, Governor effort and power.Friction:

Friction devices, Clutches, Brakes and their applications.Spur gears: Gear terminology, types of gears, Involute and Cycloid, comparison of characteristics of involute & cycloid profile, interference, Gear trains:Introduction, simple gear trains, calculation of gear ratios. **[10 Hours]**

SECTION - B

Dynamics of Reciprocating Engines: Inertia forces and Equivalent masses for different members. Turning moment diagram, Flywheel. Dynamometers: Types, Analysis of Prony-brake, Rope–brake and Belt–transmission dynamometers.Gyroscopic Action in Mechanics: Gyroscope and gyroscopic couples, Gyroscopic stabilisation of ships and airplanes, Stability of moving automobile. **[10Hours]**

Balancing : Static and Dynamic balancing, Balancing of several masses in a plane, Balancing of masses rotating in different planes, Conditions for complete balancing of an engine, Reciprocating and rotating parts. Damped vibrations :Viscous damping, Logarithmic decrement. Equivalent damping co-efficients. **[10 Hours]**

RECOMMENDED BOOKS:

1. Kinematic Analysis of Mechanisms — JE Shigley
2. Kinematics & Dynamics of Machines — George H martin
3. Mechanics of Machinery — CW Ham, EJ Craw & WL Rogers
4. Theory of Machines — Thomas Bevan
5. Elementary Kinematics of Mechanisms — Zimmerman

NOTE:

1. Question paper will be of 3 Hours' duration.
2. There will be 8 questions in all, four from **Section- A** (each of 20 marks) and four from **Section –B**(each of 20 marks)**.**
3. Students are required to attempt five questions in all, atleast two question from each section.
4. Use of scientific calculator will be allowed in the examination hall.

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CLASS: B.E. 4TH SEMESTER **CREDITS: 3**
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: MAINTENANCE ENGINEERING
COURSE NO.: PME-404
DURATION OF EXAMINATION: 3 HOURS.

L	T	P	Marks: Theory	Marks: Sessional
2	1	0	100	50

COURSE OUTCOMES At the end of the course student will be able to:	
CO404.1:	To enable the student to understand the principles, functions and practices of maintenance activities.
CO404.2:	To develop ability in formulating suitable maintenance strategies to achieve reliable manufacturing system.
CO404.3:	To introduce the different maintenance categories and failure analysis tools.
CO404.4:	To equip with essential system diagnosis techniques so as to identify and take appropriate actions on error symptoms and causes of failures.
CO404.5:	To illustrate the techniques used for maintenance management.

Detailed Syllabus

SECTION A

Maintenance – basic concepts, purpose, functions and objectives of maintenance.
Principles, benefits and effects of maintenance.Inter-relationship between productivity, quality, reliability and maintainability – maintenance productivity – quality in maintenance. Reliability – basic concepts – bathtub curve – failure rate – mean time before failure. System reliability – reliability of series and parallel systems.Maintainability – mean time to failure – mean time to repair. Availability – inherent, achieved and operational availability – reliability, availability and maintainability (RAM). **[10 Hours]**
Maintenance strategies / systems – types – basis for selection. Breakdown maintenance – corrective maintenance
Preventive maintenance – process flow – frequency in preventive maintenance.
Predictive maintenance – components – advantages and disadvantages.Condition based maintenance and condition monitoring – monitoring systems.
Performance monitoring – visual, tactile and audio monitoring – leakage monitoring.Temperature monitoring – thermography – advantages.
[10 Hours]

SECTION - B

Vibration monitoring – vibration fundamentals – vibration analysis.
Vibration transducers – types. Machinery vibration trouble shooting – machinery vibration standard, severity chart and acceptable limits. Lubricant monitoring – components and techniques – filter debris analysis &filtergrams.Introduction to Ferrography.
[10 Hours]
Reliability centered maintenance (RCM) – steps – flow diagram – basic guidelines.
Defect and failure – definitions – basics of failures – failure generation – failure analysis.
Fault tree analysis (FTA), Event tree analysis (ETA) ,Root cause analysis (RCA) , Failure modes and effects analysis (FMEA) , Failure mode effect criticality analysis (FMECA), Overall equipment effect **[14 Hours]**

Text Books:

1. Gupta A. K., Reliability, Maintenance and Safety Engineering, University Science Press, New Delhi, 2009.
2. Rao S. S., Reliability-Based Design, McGraw-Hill, Inc, New York, 1992.
3. Srivastava S. K., Maintenance Engineering and Management, S. Chand & Company Ltd., New Delhi, 1998.
4. Venkataraman, Maintenance Engineering and Management, Prentic-Hall of India Pvt. Ltd., New Delhi, 2007.
5. Davies, Handbook of Condition Monitoring, Chapman & Hall, 1996.
6. Garg M. R., Industrial Maintenance, S. Chand & Co., 1986.
7. Higgins L. R., Maintenance Engineering Hand book, McGraw Hill, 5th Edition, 1988.
8. Mishra R. C. and Pathak K., Maintenance Engineering and Management, PHI Learning Pvt. Ltd., New Delhi, 2009.

NOTE:
1. Question paper will be of 3 Hours' duration.
2. There will be 8 questions in all, four from **Section- A** (each of 20 marks) and four from**Section–B**(each of 20 marks).
3. Students are required to attempt five questions in all, at least two questions from each section
4. Use of scientific calculator will be allowed in the examination hall.

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CLASS: B.E. 4TH SEMESTER **CREDITS: 1**

BRANCH: MECHANICAL ENGINEERING

COURSE TITLE: HEAT TRANSFER LAB.

COURSE NO: PME-411

DURATION OF EXAMINATION: 3 HOURS.

L	T	P	Marks Practical
0	0	2	75

COURSE OUTCOMES At the end of the course student will be able to:	
CO411.1:	Develop concept of boundary layer formation over heated surfaces during forced and free convection, formulation of momentum and energy equations of the laminar boundary layers and their solution by approximate method.
CO411.2:	Calculate fluid temperatures, mass flow rates, pressure drops, heat exchange and effectiveness during parallel, counter and cross flow in simple and baffled-shell and tube type heat exchangers, condensers, evaporators, etc.
CO411.3:	Describe film wise and drop wise condensation in condensers, pool, forced, sub-cooled and saturated boiling in boilers and evaporators, bubble formation and critical heat flux. Model laminar film condensation and its application in the design of condensers. Evaluation of Reynolds and Nusselt numbers for boiling and condensation.
CO411.4:	Develop concept of monochromatic and total radiations, intensity of radiation, shape factor, radiation shields, solar radiation and estimation of radiative heat exchange between two or more surfaces of different geometries.
CO411.5:	Formulate and predict heat conduction problems with and without heat generation in composite walls and extended surfaces subjected to convective boundaries. Analyse 1-D unsteady and 2-D steady conduction problems.

LIST OF EXPERIMENTS:

1. To find the thermal conductivity of a given insulating material.
2. To analyse heat transfer characteristics of horizontal cylindrical fins.
3. To analyse natural heat transfer from a vertical pipe.
4. To analyse the working of a natural convection solar water heater.
5. To analyse experimentally cooling rates of a metallic plate and compare the result withthose given by theoretical predictions.
6. To analyse the temperature distribution, heat transfer coefficient and efficiency of a pin fin innatural and forced convection heat transfer.
7. To calculate overall heat transfer coefficient for both parallel/counter flow arrangement type of heat exchangerduring the operation of heat transfer form air to air, air to water, water to water.
8. To determine:

8.1 The cooling tower characteristic value.

8.2 To determine the heat transfer Co-efficient.

8.3 To determine the mass transfer Co-efficient

9. To determine:

9.1 The convective heat transfer co-efficient for heated vertical cylinder losing heat to the ambient by free or natural convection.

9.2 To find the theoretical convective heat transfer co-efficient and to compare with the experimental value.

10. To determine the value of Stefan-Boltzman constant radiation heat transfer.
11. To determine the emmisivity of test plate.
12. To determine overall heat transfer coefficient of composite wall.

NOTE:

1. At least eight practical's should be performed.
2. Additional labs/ experiment will be performed based on course content requirements.

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CLASS B.E. 4TH SEMESTER **CREDITS: 1**

BRANCH: MECHANICAL ENGINEERING

COURSE TITLE: METALLURGY AND MATERIAL SCIENCE LAB.

COURSE NO: PME-412	**L**	**T**	**P**	**Marks Practical**
DURATION OF EXAMINATION: 3 HOURS.	**0**	**0**	**2**	**50**

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO412.1:	Qualitatively describe the bonding schemes and its general physical properties as well as possible applications.
CO412.2:	Describe physical origin as well as strength of a bond.
CO412.3:	Qualitatively derive a material's Young's modulus from a potential energy curve.
CO412.4:	Index peaks and infer the structure from a simple set of diffraction data.

LIST OF EXPERIMENTS:

1. To determine the tensile strength of a given sample.
2. Hardness Testing of Ferrous and Non-Ferrous Alloys with the help of BrinellHardness testing.
3. Hardness Testing of Ferrous and Non-Ferrous Alloys with the help of Rockwell Hardness testing.
4. Hardness Testing of Ferrous and Non-Ferrous Alloys with the help of Vickers Hardness testing.
5. To test and find the impact strength of a given steel sample (both Izod and Charpy Tests)
6. To prepare specimens for micro-structural studies.
7. To analyze Microstructure of Steel and Cast Iron under Optical Microscope.
8. To find the surface cracks by Dye Penetration test.
9. To know the position of cracks using magnetic particle inspection test.

NOTE:

1. At least six practical's should be performed.
2. Additional labs/ experiment will be performed based on course content requirements.

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CREDITS: 1

CLASS: B.E. 4TH SEMESTER
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: THEORY OF MACHINES LAB
COURSE NO: PME-413
DURATION OF EXAMINATION: 3 HOURS.

L	T	P	Marks Practical
0	0	2	75

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO413.1:	Understand the kinematics of Quick Return Motion.
CO413.2:	Know about gyroscopic effect.
CO413.3:	Familiar with various cases of vibrating motion.
CO413.4:	Describe the mechanics behind the Governors

LIST OF EXPERIMENTS:

1.Find displacement, velocity and acceleration of slider of the Quick-return motion mechanism.
2. To analyse the motorized gyroscope.
3. To analyse static and dynamic balancing apparatus.
4. To analyse the torsional vibration (undamped) of single rotor shaft system.
5. To analyse various types of cams and followers.
6. To analyse various types of gear trains.
7. To analyse various types of Governors with the help of stroboscope and to determine sleeve displacement, speed of Governor and corresponding radius of Governor in case of:
   i) Watt Governor ii) Porter Governoriii) Proell Governor
8. To analyse Gearbox.
9.To analyse various types of brake systems.
10. To study the phenomenon of whirling of shafts.
11. To study theCorrollis components of acceleration.

NOTE:

1. At least seven practicals should be performed.
2. Additional labs/ experiment will be performed based on course content requirements.
3. Simulation/ virtual labs are used to enhance the practical ability of students.

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CLASS: B.E. 4TH SEMESTER **CREDITS: 1**
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: MAINTENANCE ENGINEERING LAB.
COURSE NO: PME-414
DURATION OF EXAMINATION: 3 HOURS.

L	T	P	Marks Practical
0	0	2	50

COURSE OUTCOMES At the end of the course student will be able to:	
CO414.1:	Know about the types of maintenance associated with engineering plant, equipment and systems.
CO414.2:	Know about maintenance frequency, the cost of maintenance and its effects on production.
CO414.3:	Be able to produce a maintenance plan for a specific engineering system
CO414.4:	Understand how data gathered from monitoring the performance and condition of engineering plant, equipment and systems can be used.

LIST OF EXPERIMENTS:

1. Industrial visit to identify the various types of maintenance associated with equipment and systems.
2. Collection of maintenance data from the industry.
3. To carry out Root Cause Analysis (RCA) & Failure mode and effect analysis (FMEA) to identify the possible failure and root causes of the problem.
4. To evaluate the availability and reliability of critical machine components.
5. To evaluate the OEE of an equipment/machine.
6. To evaluate the MTBF, MTTR for an equipment/machine.
7. To perform the Pareto analysis for an equipment/machine.
8. To study different probability distribution for reliability analysis.

NOTE:

1. At least six practical's should be performed.
2. Additional labs/ experiment will be performed based on course content requirements.
3. Simulation/ virtual labs are used to enhance the practical ability of students.

4th Semester Examination to be held in the Year MAY 2020,2021,2022,2023

CLASS: B.E. 4th SEMESTER **CREDITS: 1**
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: AUTO MOTIVE LAB.
COURSE NO.: PME-414
DURATION OF EXAMINATION: 3 HOURS.

L	T	P	Marks Practical
0	0	2	50

COURSE OUTCOMES	
At the end of the course student will be able to:	
CO408.1:	Familiar with various types of gears and their uses.
CO408.2:	Familiar with various types of clutches and their uses.
CO408.3:	Familiar with various steering geometry parameters.
CO408.4:	Familiar with fuel supply systems of IC Engines.
CO408.5	Familiar with braking system of automotive.

LIST OF EXPERIMENTS:

1. Study of different types of gears:
   a) Spur gear
   b) Helical gear
   c) Bevel gear
   d) Worm and Worm wheel
2. Study of different types of clutches:
   a) Cone clutch
   b) Single plate clutch
   c) Multi plate clutch
   d) Toggle clutch
3. Study of different types of Steering mechanisms:
   a) Study of different parts of a steering
   b) Check steering geometry
   c) Camber angle
   d) Caster angle
   e) King pin inclination
   f) Toe-in & Toe-out
4. Study of Fuel supply system in both CI and SI engines:
   a) Find the consumption of:
      i) Fuel in petrol engine
      ii) Air consumption, etc.
5. Maintenance of fuel system in both diesel and Petrol engines.
6. Tuning of carburetor of Petrol engine and fuel pump of Diesel engine
7. Speedy Hydraulic Brake System and bleeding of Hydraulic system to remove air block.
8. Speedy Checking Hand Brake applied as an emergency brake in cars and vehicles.
9. Study of fuel efficiency of petrol and diesel engine.

NOTE:

1. At least six practical's should be performed.
2. Additional labs/ experiment will be performed based on course content requirements.

4th Semester Examination to be held in the YearMAY 2020,2021,2022,2023

CLASS: B.E. 4thSEMESTER **CREDITS: 1**
BRANCH: MECHANICAL ENGINEERING
COURSE TITLE: MOOC
COURSE NO.: MOC- 415

L	T	P	Marks Practical
0	0	2	50

MOOC

OBJECTIVE: A massive open online course (MooC) is a model for delivering learning content to any person who wants to take a course by means of the web. It has been incorporated in the 4thsemester. Here the students will have a choice to choose between Material Science Lab Course no. PME-412 and a MooC course. To evaluate a MooCs course following is the scheme proposed:

NOTE: MOOC Adopted should be relevant to the current semester

MARKS DISTRIBUTION

- **Attendance- [10 marks]**
  Students will have to visit the lab twice a week as per the time table and pursue their respective online course.
- **Report file- [15 marks]**
  A detailed report of about 20-25 pages has to be submitted to the department at the end of the semester. It should contain details about the course that was undertaken by the student. A copy of the assignments with solutions that have been uploaded on the MooC platform should also be included in the final report. A copy of the certificate if awarded should also be appended to the report.
- **Presentation- [15 marks].**
  The presentation should be given to the peers/students focusing on the key points of the course with an aim to share the knowledge.
  Certification- [10 marks]
  The students awarded with the certificate will be given 10 marks.(Copy to be attached in the report.)

REFERENCES:

1. **NPTEL**
2. **COURSERA**