

First/Second Semester B.E./B.Tech. Degree Examination, June/July 2026 Elements of Mechanical Engineering

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. M : Marks, L: Bloom's level, C: Course outcomes.

3. Use of Steam Tables is permitted.

Module – 1			M	L	C
Q.1	a.	Define composite material. Explain the classification of composite materials with suitable examples.	10	L2	CO1
	b.	Classify the Ferrous and Non Ferrous Metal. Explain the Properties and Applications of both Metals.	10	L2	CO1
OR					
Q.2	a.	Define Nanomaterials. Explain the types of nanomaterials with suitable examples.	10	L2	CO1
	b.	Describe the applications of composite materials in aerospace and automobile industries.	10	L2	CO1
Module – 2					
Q.3	a.	With a neat sketch explain the Working principle of Four stroke SI Engine.	10	L2	CO2
	b.	5 kg of wet steam of dryness 0.8, passes from a boiler to a superheater at a constant pressure of 1MPa abs. In the super heater its temperature increases to 350 ⁰ C. Determine the amount of heat supplied in the superheater. The specific heat of superheated steam C _{ps} = 2.25 kJ/kgK.	10	L3	CO2
OR					
Q.4	a.	With a neat sketch explain the Working principle of Four stroke Diesel Engine.	10	L2	CO2
	b.	Find the specific volume and enthalpy of 1kg of steam at 0.8MPa: a) When the dryness fraction is 0.9 and b) When the Steam is Superheated to a temperature of 300 ⁰ C. The Specific heat of Super-heated steam is 2.25kJ/kgK.	10	L3	CO2
Module – 3					
Q.5	a.	List and Explain any Two Drilling Operations.	10	L2	CO3
	b.	Compare soldering and brazing processes.	10	L2	CO3
OR					
Q.6	a.	List and Explain any Two Lathe Operations.	10	L2	CO3
	b.	Describe the working principle of electric arc welding.	10	L2	CO3

Module – 4

Q.7	a.	With a Neat sketch Explain Open and Cross belt drives.	10	L2	CO5
	b.	Describe different types of robot sensors with their applications	10	L2	CO4

OR

Q.8	a.	List the Various Types of Gears. Explain any two with Sketch.	10	L2	CO5
	b.	Bring out complete classification of Robot configurations and explain any one configuration with a suitable sketch.	10	L2	CO4

Module – 5

Q.9	a.	Define Automation, classify and explain them with examples for each category.	10	L2	CO6
	b.	Explain the applications of Artificial Intelligence (AI) in the Manufacturing and automobile industry with example.	10	L2	CO6

OR

Q.10	a.	Explain the basic steps involved in additive manufacturing.	10	L2	CO6
	b.	Explain the components of CNC with block diagram.	10	L2	CO6

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1BPHYM102/202

First/Second Semester B.E./B.Tech. Degree Examination, June/July 2026 Physics of Materials (Mech stream)

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. VTU Formula Hand Book is permitted.*

Module – 1			M	L	C
Q.1	a.	Derive the expression for equivalent force constant for two springs connected in series and parallel combination and mention the expression for period of oscillation.	10	L2	CO1
	b.	Define natural frequency, period of oscillation and set up a differential equation for simple harmonic oscillations.	6	L2	CO1
	c.	A spring undergoes an extension of 5 cm for a load of 50 gm. Find its frequency of oscillations if it is set for vertical oscillations with a load of 200 gm is attached to its bottom.	4	L3	CO1
OR					
Q.2	a.	Define Resonance and obtain a differential equation for a body undergoing forced oscillations and mention expression for amplitude and phase of oscillation.	10	L2	CO1
	b.	Discuss the applications of damped oscillation in case of automatic doors closures and automobile suspension system.	6	L2	CO1
	c.	A mass of 0.5kg causes an extension of 0.03 m in spring and the system is set for oscillation, find the force constant and angular frequency .	4	L3	CO1
Module – 2					
Q.3	a.	Define three types of elastic moduli and discuss the all three factors affecting the fatigue.	9	L2	CO2
	b.	Define Stress, Strain, and explain the stress-strain curve for elastic materials.	7	L2	CO2
	c.	Calculate the Young's modulus for the material given that Poisson's ratio is 0.34615 and rigidity modulus is $4.55 \times 10^{10} \text{ N.m}^{-2}$.	4	L3	CO2
OR					
Q.4	a.	Define bending moment and derive an expression for the same in terms of moment of inertia.	8	L2	CO2
	b.	Define Static loading, Dynamic loading, Poisson's ratio and discuss the limiting value for the Poisson's ratio.	7	L2	CO2
	c.	In single cantilever experiment, find the Young's modulus of the rectangular bar of breadth 2.5 cm and thickness 0.48 cm. depression observed for the mass of 0.2 kg is 0.175 cm. Mass is suspended at a distance of 30 cm from the fixed end.	5	L3	CO2

Module – 3

Q.5	a.	State and explain the laws of thermoelectricity.	9	L2	CO3
	b.	Derive the relation between inversion temperature and neutral temperature.	6	L2	CO3
	c.	For Fe-Cu thermocouple it is observed that the thermo emf is zero when one of the junctions is at 20 °C and the other one is at some higher temperature. If the neutral temperature is 285°C, calculate the higher temperature. Hence find out the temperature of inversion, if the cold junction temperature is at -20°C.	5	L3	CO3

OR

Q.6	a.	State and discuss the Seebeck effect and Peltier effect with their coefficients.	8	L2	CO3
	b.	Describe the construction and working of thermoelectric generator (TEG).	7	L2	CO3
	c.	Calculate the neutral temperature for an iron-silver thermocouple. The values of a and b are 16.65 and -0.096 for iron and 2.86 and 0.017 for silver respectively.	5	L3	CO3

Module – 4

Q.7	a.	What is Joule-Thompson effect and derive an expression for Joule-Thompson coefficient (ΔT).	8	L2	CO4
	b.	Describe the construction and working of Platinum resistance thermometer.	8	L2	CO4
	c.	In Joule Thomson experiment temperature changes from 100°C to 150°C for a pressure change of 20MPa to 170MPa. Calculate the Joule Thomson coefficient.	4	L3	CO4

OR

Q.8	a.	Explain the liquefaction of Oxygen by the process of cascade method.	8	L2	CO4
	b.	Discuss the construction and working of liquefaction of Helium by Claude's method.	8	L2	CO4
	c.	Calculate the inversion temperature of a gas. Given $a = 0.244 \text{ atm L}^2 / \text{mol}^2$, $b = 0.027 \text{ L / mol}$, and $R = 0.0821 \text{ L atm / K / mol}$.	4	L3	CO4

Module – 5

Q.9	a.	With a labeled diagram explain the construction working of Scanning Electron Microscope (SEM).	8	L2	CO5
	b.	Explain quantum confinement in 0, 1, 2, and 3 dimensions and give the graphical representation of density of states.	8	L2	CO5
	c.	An X-ray undergoes First order Bragg's diffraction by the crystal with 'd' spacing 3.6 Å at a glancing angle 12°. Calculate wavelength of X-ray.	4	L3	CO5

OR

Q.10	a.	Derive the expression for eigen values and eigen function for particle in a 1-D potential well of finite width and infinite depth by using the 1-D Schrodinger time independent wave equation.	8	L2	CO5
	b.	With a labeled diagram explain the construction working of Atomic Force Microscope (AFM).	8	L2	CO5
	c.	Determine the crystal size given the wavelength of x-rays 12 nm, the peak width 0.5° and peak position 23° for a cubic crystal. Given $K = 0.94$.	4	L3	CO5

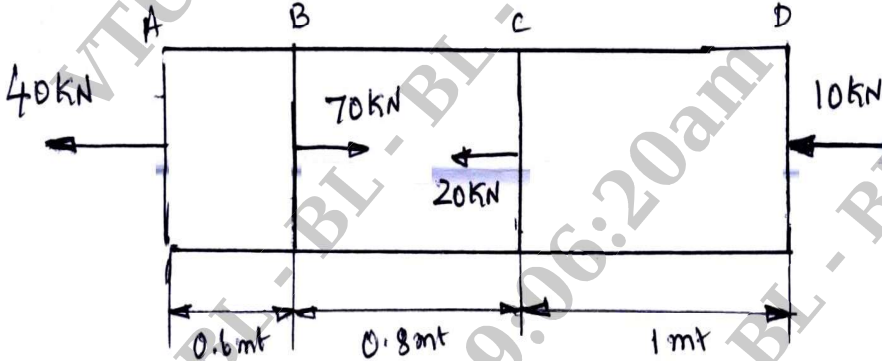
Third Semester B.E./B.Tech. Degree Examination, June/July 2026 Mechanics of Materials

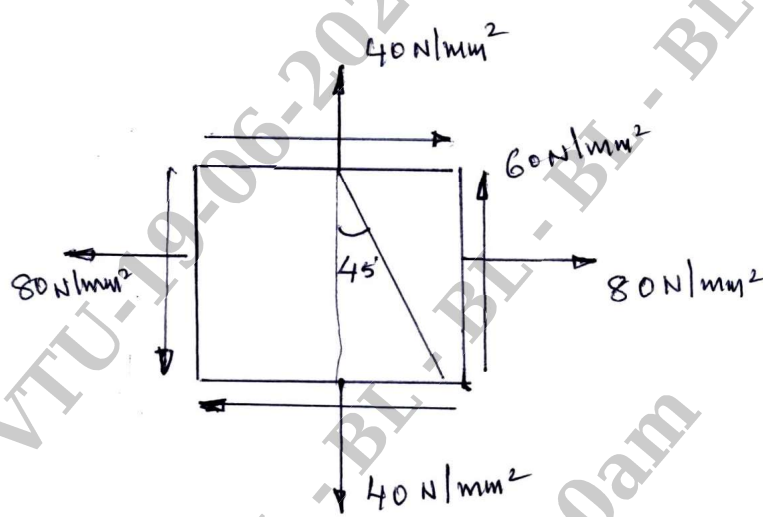
Time: 3 hrs.

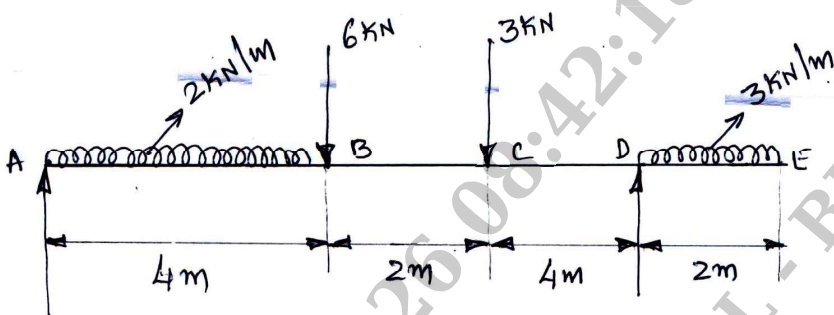
Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

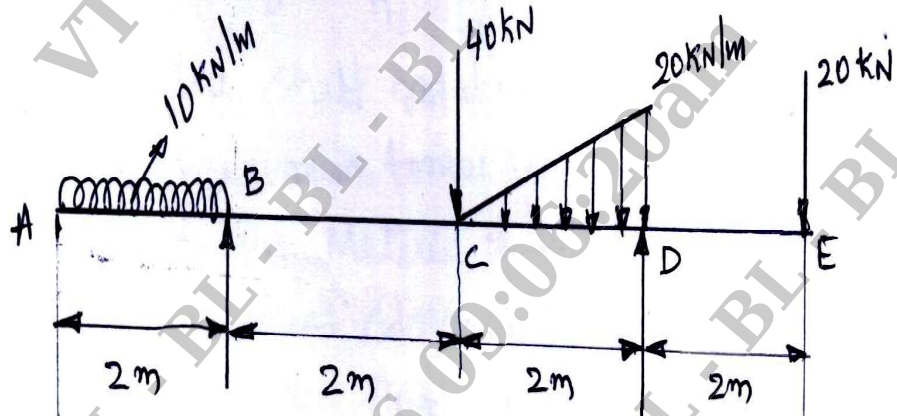
2. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1				M	L	C
Q.1	a.	Define (i) Stress (ii) Strain (iii) Young's Modulus		3	L1	CO1
	b.	Explain with a neat sketch stress-strain diagram for mild steel subjected to tensile load.		7	L2	CO1
	c.	A brass bar, having cross sectional area of 900 mm^2 is subjected to axial forces as shown in Fig. Q1 (c). Find the total elongation of the bar. Take $E = 1 \times 10^5 \text{ N/mm}^2$.  Fig. Q1 (c)		10	L3	CO1
OR						
Q.2	a.	Define (i) Modulus of elasticity (ii) Volumetric strain (iii) Bulk modulus		3	L1	CO1
	b.	Derive an expression deformation in tapering bar of circular cross section.		7	L2	CO1
	c.	An aluminium bar of 50 mm dia is stressed in a testing machine. At a certain instant the applied force is 100 kN. While measured elongation of rod is 0.219 mm in a 300 mm gauge length and decreases in diameter is 0.01215 mm. Calculate elastic constants of the materials.		10	L3	CO1
Module – 2						
Q.3	a.	What is Principal Planes and Principal Stresses?		2	L1	CO2

	b.	A point in a strained material, the stresses on two planes at right angles to each other are 80 N/mm^2 (tensile) and 40 N/mm^2 (tensile). Each of the above stress is accompanied by a shear stress of 60 N/mm^2. Determine normal stress, shear stress and resultant stress on an oblique plane inclined at an angle of 45° to the axis of minor tensile stress. Also find major principal stress minor principal stress and their location, maximum shear stress and its location. Verify the answers with Mohr's Circle Method. Refer Fig. Q3 (b)  Fig. Q3 (b)	18	L3	CO2
OR					
Q.4	a.	What are the differences between Thin and Thick cylinders?	4	L1	CO2
	b.	Derive an equation for circumferential stress in thin cylinder.	4	L2	CO2
	c.	A thin cylinder, 2 m long and 200 mm in diameter with 10 mm thickness is filled completely with a fluid, at the atmospheric pressure. If an additional 25000 mm^3 fluid is pumped in, find the longitudinal and hoop stress developed. Also determine the changes in diameter and length if, $E = 2 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio = 0.3.	12	L3	CO2
Module – 3					
Q.5	a.	Briefly explain the different types of loads.	5	L2	CO3

	b.	Draw SFD and BMD for the beam shown in Fig. Q5 (b) and also find point of contraflexure.	15	L3	CO3
 Fig. Q5 (b)					

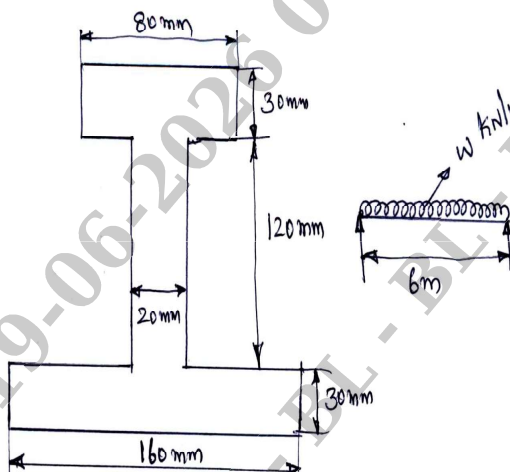
OR

Q.6	a.	Derive the relationship between load, shear force and bending moment.	5	L2	CO3
	b.	Draw SFD and BMD for a overhanging beam shown in Fig. Q6 (b) and locate the point of contraflexure.	15	L3	CO3
 Fig. Q6 (b)					

Module – 4

Q.7	a.	Prove that $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notations.	10	L2	CO4
	b.	A simply supported beam of span 5 m has a cross sectional $150\text{mm} \times 250\text{mm}$ if the permissible stress is 10 N/mm^2 , find (i) Max intensity of UDL it can carry. (ii) Max concentrated load 'P' applied at 2 m from one end it can carry.	10	L3	CO4

OR

OR					
Q.8		A Cast Iron beam of uniform section shown in Fig. Q8 is simply supported over a span of 6 m. If the limiting bending stress under tension and compression for the material are 32.5 MPa and 65 MPa respectively. Determine UDL inclusive of self weight that the beam can carry.  Fig. Q8	20	L3	CO4
Module – 5					
Q.9	a.	Derive the relation for a circular shaft when subjected to torsion as given below : $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{l}$	10	L2	CO5
	b.	A solid shaft rotating at 1000 rpm transmits 50 kW maximum torque is 20% more than the mean torque material of the shaft has the allowable shear stress of 50 MPa and modulus of rigidity 80 GPa. Angle of twist in the shaft should not exceed 1° in one metre length. Determine the diameter of the shaft. Based on strength criterion and based on rigidity criterion.	10	L3	CO5
OR					
Q.10	a.	Define slenderness ratio and derive Euler's expression for buckling load for column with both ends are hinged.	8	L2	CO5
	b.	A 1.5 m long column has a circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3. Calculate the safe load using, (i) Rankine's formula taking yield stress 560 N/mm² and $\alpha = \frac{1}{1600}$. (ii) Euler's formula, taking $E = 1.2 \times 10^5$ N/mm².	12	L3	CO5

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BME302

Third Semester B.E./B.Tech. Degree Examination, June/July 2026 Manufacturing Process

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Define Pattern. Explain any four types of pattern allowances with sketches.	10	L1	CO1
	b.	Define Core. Explain the method of a making core.	10	L1	CO1
OR					
Q.2	a.	Explain in detail the procedure to determine permeability number of green sand.	10	L2	CO1
	b.	Explain the types of gating systems with neat sketches.	10	L2	CO1
Module – 2					
Q.3	a.	Explain with a neat sketch working of a cupola furnace.	10	L2	CO2
	b.	Explain with neat sketches Casting Defects.	10	L2	CO2
OR					
Q.4	a.	Explain with a sketch Centrifugal Casting Process.	10	L2	CO2
	b.	Explain with a neat sketch Coreless Induction Furnace.	10	L2	CO2
Module – 3					
Q.5	a.	Explain any 4 sheet metal forming processes with sketches.	10	L2	CO3
	b.	Write a short note on Yield Criteria.	10	L2	CO3

OR					
Q.6	a.	With a neat sketch, explain Compound and Progressive Die Processes.	10	L2	CO3
	b.	Write the differences between Hot Working and Cold Working.	10	L2	CO3
Module – 4					
Q.7	a.	Explain with a neat sketch MIG welding process. Write its advantages and applications.	10	L2	CO4
	b.	Explain with sketches types of flames in Oxy-Acetylene Welding.	10	L2	CO4
OR					
Q.8	a.	Explain with a sketch Tungsten gas arc welding process. Write its advantages and applications.	10	L2	CO4
	b.	Explain with working of Oxy-Acetylene Welding with a sketch.	10	L2	CO4
Module – 5					
Q.9	a.	Write a short note on : i) Soldering ii) Brazing	10	L2	CO5
	b.	Explain the Welding Defects and its remedies.	10	L2	CO5
OR					
Q.10	a.	Explain the thermal effects in welding process.	10	L2	CO5
	b.	Write a short note on : i) Resistance Welding ii) Friction Stir Welding	10	L2	CO5

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BME303

Third Semester B.E/B.Tech. Degree Examination, June/July 2026 Material Science and Engineering

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1			M	L	C
1	a.	Differentiate between Crystalline and Non Crystalline solids.	5	L1	CO1
	b.	Explain Ionic and Metallic bonding with neat sketches.	5	L2	CO1
	c.	Describe the term Atomic Packing Factor and calculate APF for a BCC structure.	10	L3	CO1
OR					
2	a.	Define : i) Crystal lattice ii) Unit cell iii) Co-ordination number iv) Miller indices v) Planar density.	5	L1	CO1
	b.	Differentiate between Edge and Screw dislocations.	5	L2	CO1
	c.	Apply the concept of crystal imperfections to explain i) Point defects ii) Surface defects.	10	L3	CO1
Module – 2					
3	a.	Define Solid Solution. State Hume-Rothery rules for substitutional solid solutions.	5	L1	CO2
	b.	Explain Vacancy diffusion and Interstitial diffusion mechanisms with diagrams.	5	L2	CO2
	c.	Draw a neat sketch of the Iron-Carbon diagram and label all critical points.	10	L3	CO2
OR					
4	a.	State Fick's First and Second law of diffusion.	5	L1	CO2
	b.	Describe the Gibb's phase rule and its importance in phase diagrams.	5	L2	CO2
	c.	Draw a neat, labelled diagram of typical Cu-Ni phase diagram and explain the different phase regions.	10	L3	CO2

Module – 3

5	a.	Define Homogeneous and Heterogeneous nucleation.	5	L1	CO3
	b.	Explain the process of Annealing with a neat sketch.	5	L2	CO3
	c.	Draw a schematic TTT diagram of eutectoid steel and label all the regions.	10	L3	CO3

OR

6	a.	Derive the expression for critical radius during Homogeneous nucleation.	10	L3	CO3
	b.	Define Heat treatment and list its objectives.	5	L1	CO3
	c.	Explain the working principle of Induction hardening and Flame hardening.	5	L2	CO3

Module – 4

7	a.	Define Surface Coating and list its objectives.	5	L1	CO4
	b.	Explain Electroplating and its advantages.	5	L2	CO4
	c.	Illustrate the complete Powder Metallurgy Process with a neat flow diagram.	10	L3	CO4

OR

8	a.	List advantages and disadvantages of Powder Metallurgy.	5	L1	CO2
	b.	Explain the working principle of Chemical Vapour deposition.	5	L2	CO2
	c.	Explain powder characteristics based on particle size and shape.	10	L3	CO2

Module – 5

9	a.	Explain the properties and applications of Copper, Brass and Bronze.	10	L3	CO5
	b.	Evaluate materials based on design requirements and performance.	10	L4	CO5

OR

10	a.	Classify Engineering Materials and explain the composition and applications of grey cast iron and steels.	10	L3	CO5
	b.	Evaluate how Material Selection Charts aid in choosing suitable materials.	10	L4	CO5

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BME304

Third Semester B.E./B.Tech. Degree Examination, June / July 2026 Basic Thermodynamics

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of the thermodynamic data hand book is allowed.*

Module – 1			M	L	C
Q.1	a.	What do you understand by microscopic and macroscopic view points?	06	L1	CO1
	b.	Explain mechanical, chemical and thermal equilibrium with examples.	06	L2	CO1
	c.	With suitable examples distinguish between i) Open and Closed System ii) Path and Point – function iii) Intensive and Extensive properties.	08	L2	CO1
OR					
Q.2	a.	Define heat and work in thermodynamics. Show that work is path function.	08	L1	CO1
	b.	Derive an expression for displacement work for polytrophic process.	06	L2	CO1
	c.	A cylinder contains one kg of air at 300 K and 100 KPa. Air is compressed to one fourth of its initial volume by the law $PV^{1.25} = C$. Determine work done and heat interaction.	06	L3	CO1
Module – 2					
Q.3	a.	State the First law of thermodynamics applied to cyclic process and non cyclic process.	06	L1	CO2
	b.	Prove that internal energy is a property of a system.	06	L3	CO2
	c.	A nozzle is a device used for increasing the velocity of steadily flowing steam. At inlet the enthalpy of fluid passing is 3000 KJ/Kg and velocity is 60 m/s. At discharge the enthalpy is 2762 KJ /Kg. The nozzle is horizontal and there is negligible heat loss from it. i) Find the velocity at exit of nozzle ii) If inlet area is 0.1 m ² and Specific volume at inlet is 0.187 m ³ /kg find mass flow rate. iii) If the specific volume at exit is 0.498 m ³ /Kg, find diameter at exit of nozzle.	08	L4	CO2
OR					
Q.4	a.	What are PMMK – I and PMMK - 2? Explain why they are impossible to exist.	06	L1	CO2
	b.	With assumptions, derive SFEE for a steady flow stream of fluid entering and leaving the control volume.	06	L3	CO2

	c.	The working fluid in a steady flow process flows at the rate of 220 Kg/min. The fluid rejects 100 KJ/s of heat passing through the system. The fluid enters at a velocity of 320 m/s, pressure of 6 bar, internal energy of 2000 KJ/Kg, specific volume of $0.36 \text{ m}^3/\text{Kg}$ and leaves the system at a velocity of 140 m/s, pressure of 1.2 bar, internal energy 1400 KJ/Kg, specific volume of $1.3 \text{ m}^3/\text{Kg}$. Determine the power output in KW. The change in potential energy is neglected.	08	L3	2
Module – 3					
Q.5	a.	State Kelvin – plank and Clausius statement of Second law of thermodynamics and show that they are equivalent.	10	L2	CO3
	b.	A Series combination of two Carnot engines operate between temperature of 120°C and 20°C . Calculate the intermediate temperature. i) If the engines produces equal amount of work ii) If the efficiencies of engines are equal.	10	L3	CO3
OR					
Q.6	a.	Explain reversible and irreversible process. Mention the factors which render a process irreversible.	06	L2	CO3
	b.	State and prove Clausius inequality.	06	L2	CO3
	c.	5 Kg of copper block at 200°C is dropped to an insulated tank with 100 kg of oil at 30°C . Find the increase in entropy of the universe. Take specific heat of copper and ore as $0.4 \text{ KJ/kg} \cdot \text{K}$ and $2.1 \text{ KJ/Kg} \cdot \text{K}$ respectively.	08	L3	CO3
Module – 4					
Q.7	a.	With T.S diagram, briefly explain available energy and unavailable energy.	06	L2	CO4
	b.	Define the following terms with reference to pure substance i) Latent heat of Vapourisation ii) Sensible heat iii) Saturation temperature iv) Tripple point v) Wet steam vi) Dryness fraction vii) Critical point	14	L1	CO4
OR					
Q.8	a.	With neat sketch, explain the working of combined separating and throttling calorimeter.	10	L2	CO4
	b.	A pressure cooker contains 1.5 kg of saturated steam at 5 bar. Find the quantity of heat which must be rejected so as to reduce quality to 60 % dry. Determine the pressure and temperature at new state.	10	L4	CO4
2 of 3					

Module – 5

Q.9	a.	State and explain Dalton's law of partial pressure and Amogot's law of additive volumes.	06	L1	CO5
	b.	Explain the following : i) Reduced properties ii) Law of corresponding states iii) Vander Waal's equation of state iv) Generalized compressibility chart	14	L2	CO5
OR					
Q.10	a.	Define : i) Mole fraction ii) Mass fraction iii) Partial Pressure	06	L1	CO5
	b.	With usual notations write Clausius Clapeyron equation.	06	L2	CO5
	c.	Determine the pressure exerted by carbon dioxide in a container of 1.5 m ³ capacity when it contains 5 kg at 27° C, Using : i) Ideal gas equation ii) Vander Wall's equation Take Vander Wall's constants for Co ₂ as $a = 364.3 \text{ KN} \cdot \text{m}^4/\text{Kg} \cdot \text{mol}^2$, $b = 0.0427 \text{ m}^3/\text{k-mol}$	08	L3	CO5

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Fourth Semester B.E./B.Tech. Degree Examination, June/July 2026

Applied Thermodynamics

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. M : Marks , L: Bloom's level , C: Course outcomes.

3. Use Thermodynamics Data hand book is permitted.

Module – 1			M	L	C
Q.1	a.	With the help of PV and TS diagram, derive an expression for air standard diesel cycle.	10	L3	CO1
	b.	An ideal Otto cycle has a compression ratio of 8. The conditions at the beginning of compression stroke are 100 kPa and 17°C. If the heat added during the cycle is 800 kJ/kg, find (i) Temperatures and pressures at all salient points of the cycle. (ii) Network output (iii) Thermal efficiency of the cycle	10	L3	CO1
OR					
Q.2	a.	Explain, with the help P-θ diagram, the phenomenon of combustion in S.I engines.	10	L2	CO1
	b.	The following observations are recorded in 60 minute duration on a single cylinder, 4-stroke, S.I. engine : Bore = 220 mm, Stroke = 300 mm, Fuel used = 4 kg, Calorific value of fuel = 42000 kJ/kg, Speed of the engine = 300 rpm, m.e.p = 5 bar, Load on the brake drum = 600 N, Spring balance reading = 30 N, Diameter of the brake drum = 1.4 m, Quantity of cooling water = 500 kg Temperature rise of the cooling water = 20°C, A/F ratio = 16, Exhaust gas temperature = 410°C, Sp.heat of exhaust gas = 1.1 kJ/kgK, Ambient temperature = 30°C. Calculate : (i) IP (ii) BP (iii) Brake thermal efficiency (iv) Indicated thermal efficiency (v) BSFC Also draw a heat balance sheet on minute basis.	10	L4	CO1
Module – 2					
Q.3	a.	With a neat schematic and cycle on T-S diagram, derive an expression for efficiency of an ideal regenerative gas turbine cycle.	10	L3	CO2
	b.	Air enters the compressor of an open cycle gas turbine at a pressure of 1 bar and temperature of 20°C. The pressure of air after compression is 4 bar. The isentropic efficiency of compressor and turbine are 80% and 85% respectively. The air fuel ratio is 90 : 1. If the flow rate of air is 3 kg/s, $\gamma = 1.4$ and $C_p = 1.0$ kJ/kg for both air and gas the calorific value of fuel is 41800 kJ/kg, find the power developed and the thermal efficiency of the cycle.	10	L3	CO2

OR					
Q.4	a.	With neat sketch and cycle on T-S diagram, explain the working of Ramjet engine.	10	L2	CO2
	b.	In a reheat gas turbine cycle, comprising one compressor and two turbines, air is compressed from 1 bar, 27°C to 6 bar. The highest temperature in the cycle is 900°C. The expansion in the first stage turbine is such that the work output from it just equals the work required by the compressor. Air is reheated between the two stages of expansion to 850°C. Calculate : (i) Intermediate pressure between HP and LP turbine (ii) Cycle efficiency	10	L3	CO2
Module – 3					
Q.5	a.	Discuss the effect of : (i) Condenser pressure (ii) Boiler pressure (iii) Super heat on the performance of a Rankine cycle.	10	L2	CO3
	b.	In a reheat vapour power cycle, the initial steam pressure and the maximum temperature are 150 bar, and 550°C respectively. If the condenser pressure is 0.1 bar and the moisture content at the condenser inlet is 5%, determine (i) Reheat pressure (ii) Cycle efficiency (iii) Steam rate if the steam is reheated to 550°C	10	L3	CO3
OR					
Q.6	a.	With a schematic diagram, and the cycle on T-S or h-s diagram, derive an expression for an efficiency of practical regenerative Rankine cycle.	10	L3	CO3
	b.	Steam at 30 bar, 350°C is supplied to a steam turbine in a practical regenerative cycle and the steam is bled at 4 bar. The bled steam comes out as dry saturated steam and heats the feed water in an open feed water heater to its saturated liquid state. The rest of the steam in the turbine expands to condenser pressure of 0.1 bar. Assuming the turbine efficiency to be same before and after bleeding , determine : (i) Turbine efficiency (ii) Quality of steam at inlet of the condenser (iii) Mass of steam bled per kg of boiler steam and (iv) Cycle efficiency.	10	L4	CO3
Module – 4					
Q.7	a.	Derive an expression for COP of vapour compression refrigeration system. Show the schematic diagram and cycle on p-h chart.	6	L2	CO4

	b.	List the desirable properties of refrigerant.	4	L1	CO4
	c.	An ammonia vapour compression refrigerator works between an evaporator pressure of 1.2 bar and a condenser pressure of 12 bar. The refrigerant leaves the evaporator at -20°C and leaves the condenser at +20°C. Determine the COP and power required per ton of refrigeration. Determine also the bore and stroke of the compressor cylinder if the speed is 200 rpm, volumetric efficiency is 0.8 and stroke is 1.5 times the bore.	10	L4	CO4
OR					
Q.8	a.	With a neat schematic diagram and the processes on the skeleton of psychrometric chart, explain the summer air conditioning system for hot and dry weather conditions.	10	L2	CO4
	b.	It is required to design an air conditioning plant for a small office room for the following winter conditions: Outdoor conditions : 14°C DBT and 10°C WBT Required conditions : 20°C DBT and 60% RH Amount of free air circulation : 0.3 m ³ /min/person, Seating capacity of office : 60 The required condition is achieved first by heating and then by adiabatic humidifying. Determine : (i) Heat capacity of coil in kW and the surface temperature of the coil if the by-pass factor is 0.4 (ii) Capacity of the humidifier.	10	L3	CO4
Module – 5					
Q.9	a.	What are the uses of compressed air?	4	L1	CO5
	b.	Derive an expression for volumetric efficiency of reciprocating compressor in terms of clearance ratio, pressure ratio and index compression.	6	L3	CO5
	c.	In a two stage reciprocating air compressor, 1.5 kg/min of air is compressed from 1 bar to 25 bar and the index of compression is 1.2. If the work of compression is minimum and the air is cooled in the inter cooler so that its temperature is brought back to initial temperature of 15°C, determine : (i) Heat rejected in the intercooler and (ii) The power required to drive the compressor	10	L3	CO5
OR					
Q.10	a.	Derive an expression of critical pressure ratio for maximum discharge through the nozzle.	10	L3	CO5

	b.	A steam nozzle is supplied steam at 15 bar, 350°C and discharges at 1 bar. If the diverging portion of the nozzle is 80 mm long and the throat diameter is 6 mm, determine the cone angle of divergent portion. Assume 12% of the total available enthalpy drop is lost in friction in the divergent portion. Also determine the velocity and temperature of the steam at throat.	10	L3	CO5
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Fourth Semester B.E./B.Tech. Degree Examination, June/July 2026

Machining Science and Metrology

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Define Metal Cutting. With a suitable sketch explain the mechanics of metal cutting.	06	L2	CO1
	b.	With a neat sketch, explain Merchant's circle diagram, add the advantages and limitations of it.	06	L3	CO1
	c.	Distinguish between Orthogonal and Oblique Cutting.	08	L2	CO1
OR					
Q.2	a.	What is a Lathe? With a line diagram explain the lathe specifications.	04	L1	CO2
	b.	With a neat diagram explain any 'five' lathe operations.	10	L1	CO2
	c.	State the differences between Capstan and Turret Lathes.	06	L1	CO2
Module – 2					
Q.3	a.	Explain with neat sketch Up milling and Down milling operation.	06	L1	CO2
	b.	Explain any 'four' milling machine operations.	08	L1	CO2
	c.	With a neat sketch explain vertical milling machine.	06	L1	CO2
OR					
Q.4	a.	With a neat sketch explain Quick Return Mechanism used in shaper.	06	L2	CO2
	b.	With a neat sketch explain the nomenclature of single point cutting tool.	06	L2	CO2
	c.	Explain with sketch any 4 drilling machine operations.	08	L1	CO2
Module – 3					
Q.5	a.	Discuss the factors that influence the amount of heat generated during the metal cutting.	06	L2	CO3
	b.	What are the primary forms of tool wear in metal cutting? Explain Crater wear and Flank wear in detail.	08	L2	CO3
	c.	A carbide cutting tool lasted for 150 min while machining mild steel at 35 m/min. If a similar tool is used at 30% higher speed to machine mild steel, calculate the tool life. Also calculate the value of cutting speed if the tool is to machine for 2 hours. Assume $n = 0.3$ in Taylor's tool life equation $VT^n = C$.	06	L3	CO3

OR

Q.6	a.	Discuss the relationship between the work material properties and its machinability.	06	L1	CO3
	b.	Write short notes on the following tool materials : (i) HSS (i) Cemented carbide (iii) Ceramics (iv) Cubic boron nitride.	08	L1	CO3
	c.	Explain the criterion for selecting an appropriate cutting fluid.	06	L1	CO3

Module – 4

Q.7	a.	Define Metrology. State and explain the objectives of metrology.	05	L1	CO4
	b.	What do you mean by Standard? Explain line and end standard. Also comment on wringing of slip gauges.	08	L1	CO4
	c.	What do you mean by Interchangeability? Explain taking any suitable example.	07	L2	CO4

OR

Q.8	a.	Define the following terms: (i) Limits (ii) Fits (iii) Tolerance (iv) Fundamental deviation	08	L1	CO4
	b.	Discuss the different types of fits and their designation with neat sketches.	06	L1	CO4
	c.	Write short notes on : (i) Compound Tolerance (ii) Cost v/s Tolerance	06	L1	CO4

Module – 5

Q.9	a.	What are 'GO' and 'NOGO' gauges? Explain how Taylor's principle is used in designing them.	06	L1	CO4
	b.	Sketch and explain any two types of plug and ring gauges.	08	L1	CO4
	c.	Explain briefly the Gauge Tolerances.	06	L1	CO4

OR

Q.10	a.	Define Comparator. Explain mechanical comparator. Add sketch.	07	L1	CO5
	b.	With a neat sketch explain LVDT.	06	L1	CO5
	c.	What do you mean by Angular Measurement? Explain any one method adding suitable sketch.	07	L1	CO5

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Fourth Semester B.E./B.Tech. Degree Examination, June/July 2026

Fluid Mechanics

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks, L: Bloom's level, C: Course outcomes.*

Module – 1				M	L	C
Q.1	a.	Define the following terms with SI units : i) Weight Density ii) Viscosity iii) Compressibility iv) Capillarity		08	L1	CO1
	b.	The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The diameter of the shaft is 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm.		08	L3	CO1
	c.	Classify the Manometers.		04	L1	CO1
OR						
Q.2	a.	The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm.		08	L3	CO1
	b.	Derive an expression for total pressure force and centre of pressure on a vertical plane surface immersed in static fluid.		08	L3	CO1
	c.	Define the following terms: (i) Total Pressure (ii) Centre of Pressure		04	L1	CO1
Module – 2						
Q.3	a.	Differentiate between : (i) Steady and Unsteady Flow (ii) Uniform and Non-uniform Flow (iii) Laminar and Turbulent Flow		06	L2	CO2
	b.	Derive the 3-dimensional flow continuity equation in Cartesian coordinates.		08	L3	CO2
	c.	The velocity potential function is given by $\phi = 5(x^2 - y^2)$. Calculate the velocity components at the point (4, 5).		06	L3	CO2
OR						
Q.4	a.	Derive the Hagen Poiseulle equation for laminar flow through a circular pipe.		12	L3	CO2
	b.	A crude oil of viscosity 0.9 poise and specific gravity 0.8 is flowing through a horizontal circular pipe of diameter 80 mm and of length 15 m. Calculate the difference of pressure at the two ends of the pipe, if 50 kg of oil is collected in a tank in 15 seconds. Also calculate the loss of pressure head.		08	L3	CO2

Module – 3

Q.5	a.	Derive the Euler's equation of fluid motion and hence deduce Bernoulli's equation.	10	L3	CO3
	b.	Derive an expression for discharge over a triangular notch.	10	L3	CO3

OR

Q.6	a.	Mention any five minor energy loss with equations.	05	L1	CO3
	b.	Derive Darcy – Weisbach equation for determining loss of head due to friction.	10	L3	CO3
	c.	Water is flowing through a pipe of 100 mm diameter under a pressure of 19.62 N/cm^2 and with mean velocity of 3.0 m/s. Find the total head of the water at a cross section which is 8 m above the datum line.	05	L3	CO3

Module – 4

Q.7	a.	Explain the following terms: i) Boundary layer thickness ii) Streamline body iii) Bluff body iv) Lift v) Drag	10	L2	CO4
	b.	A flat plate $1.5 \text{ m} \times 1.5 \text{ m}$ moves at 50 km/hr in stationary air of density 1.15 kg/m^3 . The coefficient of drag and lift are 0.15 and 0.75 respectively. Compute : (i) Lift force (ii) Drag force (iii) Resultant force (iii) Power required to keep the plate in motion.	10	L3	CO4

OR

Q.8	a.	Explain the following terms: i) Reynold's number ii) Froude's number iii) Euler's number iv) Weber's number v) Mach's number	10	L2	CO4
	b.	The efficiency of fan depends on density ρ , dynamic viscosity μ of the fluid, angular velocity ω , diameter D of the rotor and the discharge Q. Express η in terms of dimensionless parameters.	10	L3	CO4

Module – 5

Q.9	a.	Show that velocity of elastic wave propagation in an adiabatic medium is given by $C = \sqrt{kRT}$.	10	L3	CO5
	b.	A projectile travels in air of pressure 10.1043 N/cm^2 at 10°C at a speed of 1500 km/hr. Find the Mach number and the Mach angle. Take $K = 1.4$ and $R = 287 \text{ J/kg K}$.	10	L3	CO5

OR

Q.10	a.	Deduce an expression for velocity of sound wave in a fluid.	10	L3	CO5
	b.	Explain the necessity, applications and limitations of CFD.	10	L2	CO5

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21ME51

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026 Theory of Machines

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define the following terms :
 - (i) Mechanism
 - (ii) Structure
 - (iii) Degree of freedom
 - (iv) Kinematic pair
 - (v) Inversion of mechanism

(10 Marks)
- b. Explain the following inversions of four-bar chain with neat sketches:
 - (i) Beam Engine
 - (ii) Coupling rod of a locomotive

(10 Marks)

OR

- 2 PQRS is a four bar mechanism with link PS fixed as shown in Fig.Q2. The lengths of the links are $PQ = 62.5$ mm, $QR = 175$ mm, $RS = 112.5$ mm, $PS = 200$ mm. The crank PQ rotates at 10 rad/sec clockwise. Draw the velocity and acceleration diagrams when angle $QPS = 60^\circ$ and 'Q' and 'R' lie on the same side of PS. Find angular velocity and angular acceleration of links QR and RS.

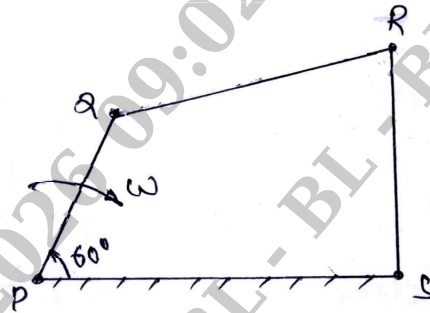


Fig.Q2

(20 Marks)

Module-2

- 3 a. Discuss the conditions for static equilibrium of the following :
 - i) Two force member
 - ii) Three force member
 - iii) Two force and a torque member

(06 Marks)
- b. A four bar mechanism as shown in Fig.Q3(b), is acted upon by a force $P = 100\sqrt{120}$ N on link CD. The dimensions of various links are $AB = 40$ mm, $BC = 60$ mm, $CD = 50$ mm, $DA = 30$ mm and $DE = 20$ mm. Determine the magnitude and direction of input torque 'T' on the link AB for the static equilibrium of the mechanism.

(14 Marks)

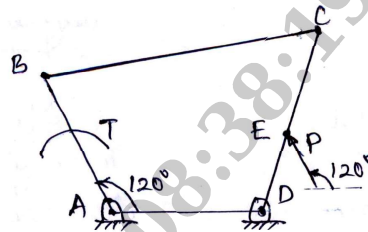


Fig.Q3(b)

OR

- 4 a. State and explain D' Alembert's principle. (04 Marks)
- b. A punching machine is operated by an electric motor which supplies a constant torque. The motor delivers 3.68 KW. At the commencement of operation the flywheel of the punching machine has a speed of 300 rpm. The moment of inertia of the flywheel is 60 kg-m^2 . Each punching operation requires 5600 N-m of energy and actual punching takes 1 sec. Find:
- The number of punchings that can be made in an hour.
 - The reduction in speed after punching is over.
- (16 Marks)

Module-3

- 5 a. State and prove the law of gearing with neat sketch. (05 Marks)
- b. The two involute spur gears of 19 and 47 teeth respectively are in mesh. This module is 6.5 mm, pressure angle is 20° and 6.5 mm addendum. Determine the number of pair of teeth in contact and the angle turned by the pinion and gear wheel for one pair of teeth in contact. (15 Marks)

OR

- 6 a. Sketch and explain :
 i) Simple gear train ii) Compound gear train. (06 Marks)
- b. Two shafts 'A' and 'B' are co-axial. The gear 'C' (50 teeth) is rigidly mounted on shaft 'A'. The compound gear D-E gears with 'C' and an internal gear 'G'. 'D' has 20 teeth and gears with 'C' and 'E' has 35 teeth gears with an internal gear 'G'. The gear 'G' is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft 'B' as shown in Fig.Q6(b). Find the number of teeth on internal gear 'G' assuming that all gears have the same module. If the shaft 'A' rotates at 110 rpm. Find the speed of shaft 'B'.

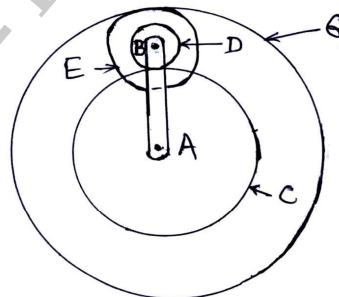


Fig.Q6(b)

(14 Marks)

Module-4

- 7 a. Explain Static and Dynamic balancing of rotating masses. (04 Marks)
- b. A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm 60 mm and 80 mm in planes measured from 'A' at 300 mm, 400 mm and 700 mm. The angles between the cranks measured A.C.W are A to B 45° , B to C 70° and C to D 120° . The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. (16 Marks)

OR

- 8 a. Explain the balancing of primary and secondary forces in multi-cylinder in-line engines. (06 Marks)
- b. The arms of a porter governor are each 300 mm long and are pivoted on the governor axis. The mass of each ball is 5 kg and the mass of central sleeve is 15 kg. The radius of rotation of the balls is 200 mm when the sleeve begins to rise and reaches a value of 250 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 30 N of load at the sleeve, determine how the speed range is modified. (14 Marks)

Module-5

- 9 a. Briefly explain the following :
 i) Free and forced vibration
 ii) Damped and Undamped vibrations
 iii) Deterministic and Random vibrations
 iv) Longitudinal and Transverse vibrations
 v) Torsional and Transient vibrations. (10 Marks)
- b. Determine the natural frequency of oscillation of the shown in Fig.Q9(b), using energy method.

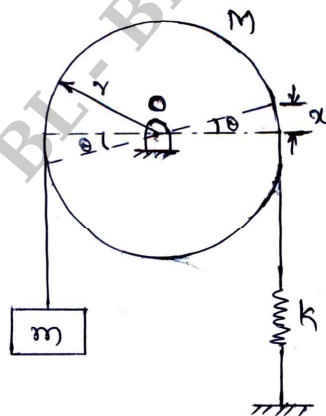


Fig.Q9(b)

(10 Marks)

OR

- 10 a. Define Transmissibility and derive an expression for the Transmissibility ratio and the phase angle for transmitted force. (10 Marks)
- b. A machine of mass one tone is acted upon by an external force of 2450 N at a frequency of 1500 rpm. To reduce the effects of vibration, isolator of rubber having a static deflection of 2 mm under the machine load and an estimated damping factor of 0.2 are used. Determine
- (i) Force transmitted to the foundation
 - (ii) Amplitude of vibration of the machine
 - (iii) Phase lag of transmitted for with respect to the external force. (10 Marks)

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21ME53

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026 Finite Element Analysis

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Define FEA. Explain the basic steps involved in problem solving in FEA. (10 Marks)
- b. With an example, explain node numbering scheme and node location system. (10 Marks)

OR

- 2 a. Using minimum potential energy determine the nodal displacement of a spring system shown in Fig. Q2 (a). (10 Marks)

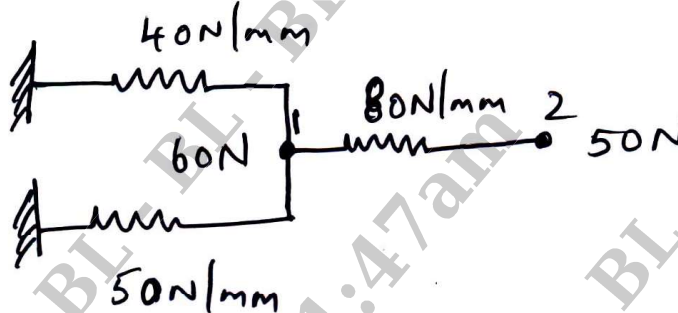
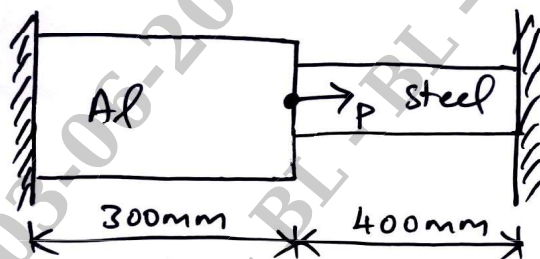


Fig. Q2 (a)

- b. Explain simplex, complex and multiplex elements. (10 Marks)

Module-2

- 3 a. Derive the elemental stiffness matrix for 1D bar element. (10 Marks)
- b. For the stepped bar shown in Fig. Q3 (b). Determine the nodal displacements, stress in each element. (10 Marks)



$$E_{Al} = 70 \times 10^9 \text{ N/m}^2 \quad E_{St} = 200 \times 10^9 \text{ N/m}^2$$

$$A_{Al} = 2400 \text{ mm}^2 \quad A_{St} = 600 \text{ mm}^2$$

$$P = 200 \text{ kN}$$

Fig. Q3 (b)

OR

- 4 a. Derive an expression for a shape function 4-noded tetrahedral element (TET4). (10 Marks)
 b. Derive an shape function for a cubic element in natural coordinates. (10 Marks)

Module-3

- 5 a. Derive Hermite shape function for a beam element. (10 Marks)
 b. Find the deflection at the free end and the support reaction of a cantilever beam shown in Fig. Q5 (b). (10 Marks)

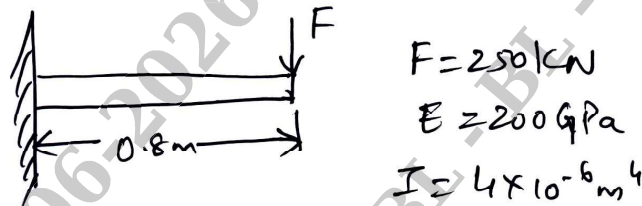


Fig. Q5 (b)

OR

- 6 a. Derive stiffness matrix for a circular shaft subjected to pure torsion. (10 Marks)
 b. A solid stepper bar of circular cross section is subjected to a torque of 1 kN-m at its free end and to a torque of 3 kN-m at its change in cross section as shown in Fig. Q6 (b). Determine the angle of twist and shear stresses in the bar. Take $E = 2 \times 10^5\text{ N/mm}^2$ and $G = 7 \times 10^4\text{ N/mm}^2$. (10 Marks)

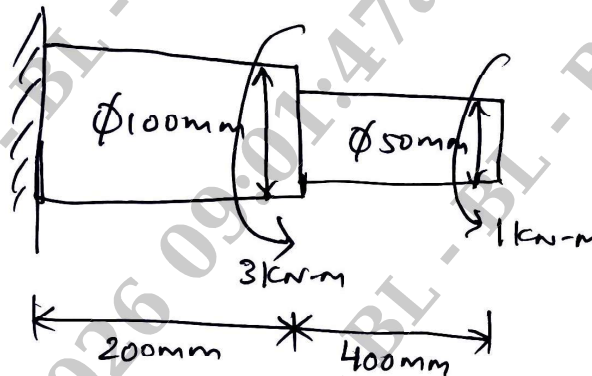


Fig. Q6 (b)

Module-4

- 7 a. With usual notations, derive the differential equation for 1-D heat conduction body. (10 Marks)
 b. Determine the temperature distribution in the rectangular fin as shown in Fig. Q7 (b). Assume steady state and only conduction process. Take heat generated inside the fin as 400 W/m^3 . (10 Marks)

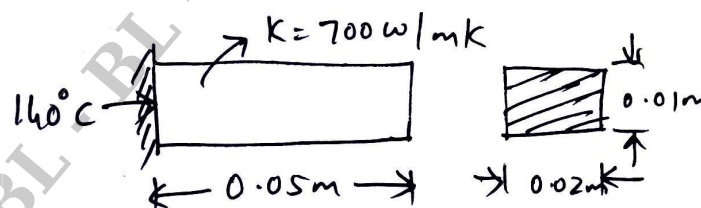


Fig. Q7 (b)

OR

- 8 For the smooth pipe shown in Fig. Q8 with uniform C/S of 1 m^2 , determine the flow velocities at the centre and right end, knowing the velocity at the left is $V_x = 2 \text{ m/sec}$.

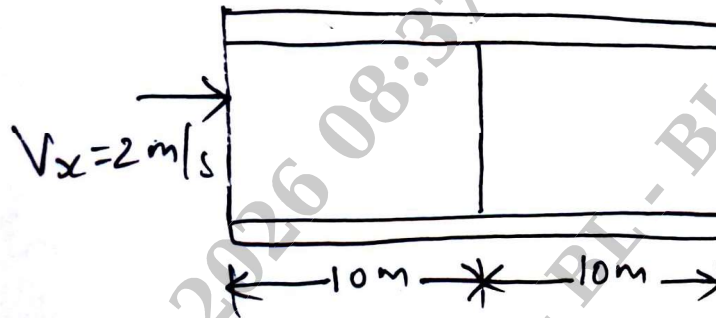


Fig. Q8

(20 Marks)

Module-5

- 9 a. Derive an expression for the body force vector of an axis-symmetric solid element. (10 Marks)
 b. Evaluate the nodal forces used to replace the linearly varying surface traction shown in Fig. Q9 (b). (10 Marks)

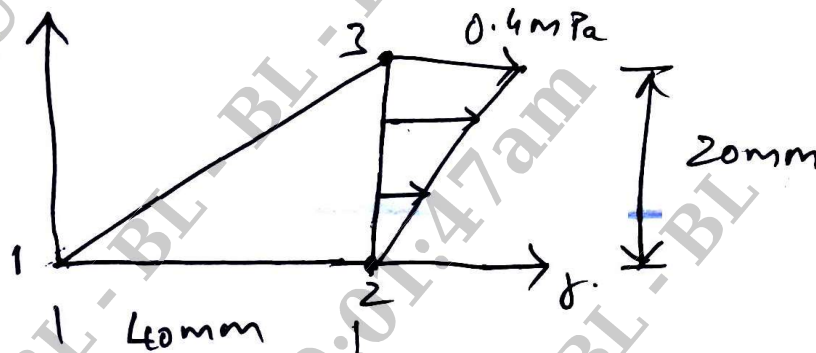


Fig. Q9 (b)

OR

- 10 a. Derive an equation for lumped matrix for 1D bar element. (10 Marks)
 b. Evaluate Eigen value of longitudinal vibration of the constrained uniform bar shown in Fig. Q10 (b). Take minimum two elements. Take $E = 210 \text{ GPa}$ and $\delta = 7860 \text{ kg/m}^3$. (10 Marks)

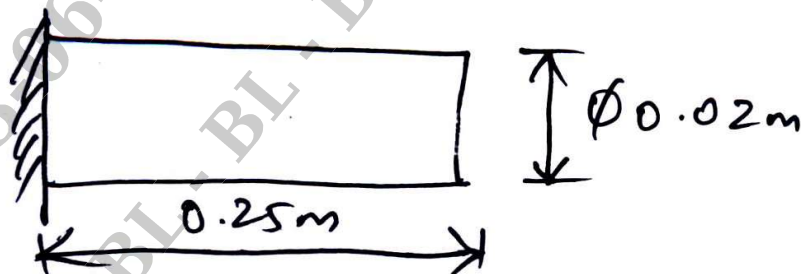


Fig. Q10 (b)

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BMT/BSA/BME/BAG501

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026 Industrial Management & Entrepreneurship

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Explain the nature of management.	10	L2	CO1
	b.	Describe briefly early classical management studies.	10	L1	CO1
OR					
Q.2	a.	Define Planning and explain its nature.	10	L1	CO1
	b.	Describe different types of planning.	10	L1	CO1
Module – 2					
Q.3	a.	Define Organization. Explain principles of organization.	10	L1	CO2
	b.	Describe the span of control.	10	L1	CO2
OR					
Q.4	a.	Explain the meaning and nature of directing.	10	L2	CO2
	b.	Explain steps in the control process.	10	L2	CO2
Module – 3					
Q.5	a.	What is the meaning of entrepreneur? What are the importance of entrepreneurship?	10	L1	CO3
	b.	List types of entrepreneur. Explain any one type in detail.	10	L1	CO3
OR					
Q.6	a.	Define Entrepreneurship. Explain its concept.	10	L1	CO3
	b.	Describe the problems faced by entrepreneurs.	10	L1	CO3
Module – 4					
Q.7	a.	Explain the need and rationale of Small Scale Industries (SSI).	10	L2	CO4
	b.	What are the advantages of SSIs and steps to start a SSI.	10	L1	CO4
OR					
Q.8	a.	Explain the impact of liberalization, privatization and globalization on SSIs.	10	L2	CO4

	b.	Write a note on : (i) Ancillary industry (ii) Tiny industry	10	L1	CO4
Module – 5					
Q.9	a.	List various institutional support for SSI?	10	L1	CO5
	b.	Explain National Small Industries Corporation (NSIC) in brief.	10	L2	CO5
OR					
Q.10	a.	Explain project identification and project selection.	10	L2	CO6
	b.	List the contents of the project report.	05	L1	CO6
	c.	Explain the importance of network analysis.	05	L2	CO6

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Fifth Semester B.E./B.Tech. Degree Examination, June /July 2026

Turbo Machines

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1			M	L	C
Q.1	a.	Compare positive displacement machine with turbomachine.	06	L2	CO1
	b.	A centrifugal pump works against a manometric head of 30 m with an impeller diameter of 300 mm. When the pump was running at 1500 rpm it produced a head of 22 m. What changes in design do you suggest to get the designed head of 30 m.	08	L3	CO1
	c.	Define specific speed of turbine. Obtain the expression for specific speed of turbine.	06	L3	CO1
OR					
Q.2	a.	For Power generating Turbomachine, define : i) total –to total Efficiency ii) total to static Efficiency	04	L1	CO1
	b.	Define the term infinitesimal stage Efficiency of a turbine. Show that the polytrophic Efficiency during the Expansion process is given by $\eta_p = \frac{\ln\left(\frac{T_2}{T_1}\right)}{\frac{\gamma-1}{\gamma} \ln\left(\frac{P_2}{P_1}\right)}$	08	L3	CO1
	c.	Air flows through an air turbine where its stagnation pressure is reduced in the ratio 5:1 the total to total Efficiency is 80%. The air flow rate is 5 kg/s. If the total power output is 500 kW, find : i) Inlet total temperature ii) actual exit total temperature iii) actual Exit Static temperature, if the flow velocity is 100 m/s iv) total to static Efficiency.	08	L3	CO1
Module – 2					
Q.3	a.	Derive alternate form of Euler turbine Equation and explain the significance of each component of energy transfer.	07	L3	CO2
	b.	Show that $\epsilon_{\max}$ of an axial flow turbine with degree of reaction $R = \frac{1}{4}$, the relationship of blade speed U to absolute velocity at rotor inlet V_1 , should be $\frac{U}{V_1} = \frac{2}{3} \cos \alpha_1$ Where α_1 – Nozzle angle at inlet. Assume flow velocity is constant from inlet to outlet.	07	L3	CO2

BME502					
	c.	At a 50% reaction stage axial flow turbine, the mean blade diameter is 60 cm. The maximum utilization factor is 0.9. Steam flow rate is 10kg/s. Calculate the inlet and outlet absolute velocities and power developed if the speed is 2000 rpm.	06	L3	CO2
OR					
Q.4	a.	Obtain an Expression for Energy transfer $E = 2 V_f^2 (2 - \cot \beta_2)$ and degree of reaction $R = \frac{2 + \cot \beta_2}{4}$ Make the following assumptions i) $U_2 = 2U_1$ ii) Constant flow velocity $V_{f_1} = V_{f_2} = V_f$ iii) no inlet whirl velocity $V_{u_1} = 0$ iv) inlet blade angle $\beta_1 = 45^\circ$	10	L3	CO2
	b.	In an axial flow compressor show that Energy transfer $E = u V_a (\cot \beta_1 - \cot \beta_2)$ and degree of reaction $R = \frac{V_a}{2U} (\cot \beta_1 + \cot \beta_2)$	10	L3	CO2
Module – 3					
Q.5	a.	Prove that the maximum blade Efficiency for a single stage impulse turbine with equiangular rotor blades is given by $\eta_{b \max} = (1 + C_b) \frac{\cos^2 \alpha_1}{2}$ Where C_b - blade velocity coefficient.	10	L3	CO3
	b.	Steam flows through the nozzle with a velocity of 450 m/s at a direction which is inclined at an angle of 16° to the wheel tangent. Steam comes out of the moving blades with a velocity of 100 m/s in the direction of 110° with the direction of blade motion. The blades are Equiangular and the steam flow rate is 10 kg/s. Find i) Power developed ii) The power loss due to friction iii) Axial thrust iv) Blade Efficiency v) Blade velocity coefficient	10	L3	CO3
OR					
Q.6	a.	Show that for a Curtis stage the maximum Efficiency is given by $\eta_{\max} = \cos^2 \alpha_1$	12	L3	CO3
	b.	A stage of a turbine with Parson's blading deliver dry saturated steam at 2.7 bar ($\rho = 1.496 \text{ kg/m}^3$) from the fixed blades at 90 m/s. The mean blade height is 40 mm and the moving blade Exit angle is 20° . The axial velocities of steam is $\frac{3}{4}$ of the blade velocity at the mean radius. Steam is supplied to the stage at the rate of 2.5 kg/s. The Effect of the blade tip on the annulus area can be neglected calculate i) The wheel speed ii) The diagram Efficiency iii) The diagram power	08	L3	CO3

Module – 4

Q.7	a.	Show that for a Pelton wheel $\eta_{b\max} = \frac{1 + C_b \cos \beta_2}{2}$	10	L3	CO4
	b.	A double jet Pelton – wheel is required to generate Electric Power of 7500 kW when the available head at the base of the nozzle is 400 m. The jet is deflected through 165° and the relative velocity of the jet is reduced by 15% in passing over the buckets. Determine : i) Total Flow ii) The diameter of each jet iii) Force exerted by the jets in the tangential direction. Assume Generator Efficiency = 95%, Overall Efficiency $\eta_o = 80\%$, Speed ratio = 0.47.	10	L3	CO4

OR

Q.8	a.	Draw the cross sectional view of a Kaplan turbine and explain its working. Also sketch the velocity triangles at inlet and outlet of a Kaplan runner.	08	L2	CO4
	b.	For francis turbine, show that hydraulic efficiency $\eta_h = \frac{2}{2 + \tan^2 \alpha_1}$; where α_1 – flow angle at inlet and given that i) Component of velocity normal to the tangential direction is constant from inlet to outlet ($V_{f_1} = V_{f_2}$) ii) Relative velocity at the inlet is radial iii) Absolute velocity at outlet is radial sketch the velocity triangles.	06	L3	CO4
	c.	What is Draft tube? Explain the functions of Draft tube.	06	L2	CO4

Module – 5

Q.9	a.	Define the following : i) Manometric head ii) Cavitation iii) Slip & Slip Factor	06	L1	CO5
	b.	Derive an Expression for minimum starting speed of a centrifugal pump.	06	L3	CO5
	c.	A centrifugal pump runs at 950 rpm. Its outer and inner diameters are 500 mm and 250 mm. The vanes are set back at 35° to the wheel rim. If the radial velocity of water through the impeller is constant at 4 m/s, Find : i) Vane angle at inlet ii) Velocity of water at the outlet and its direction iii) Workdone by the impeller per kg of water. Entry of water at inlet is radial.	08	L3	CO5

OR

Q.10	a.	With a neat sketch discuss the arrangements of pumps connected in i) Series ii) Parallel	06	L2	CO5
	b.	Explain surging and stalling in centrifugal compressors.	06	L2	CO5
	c.	A centrifugal compressor rotor has inlet diameter of 60 cm and outer diameter is 120 cm. Entry is radial with a component of 60 m/s which is constant throughout. The compressor requires 700 kW of power to handle 20 kg of air per second. Find the blade angles at inlet and outlet if the compressor runs at 5100 rpm. Calculate the width at inlet and outlet, if specific volumes at inlet and outlet are respectively $0.85 \text{ m}^3/\text{kg}$ and $0.71 \text{ m}^3/\text{kg}$. Take $\eta_o = 1$. What is the degree of reaction?	08	L3	CO5

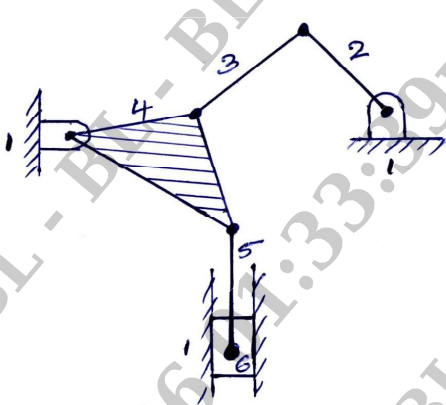
Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026

Theory of Machines

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1				M	L	C
Q.1	a.	Define the following: i) Lower pair ii) Higher pair iii) Structure iv) Mechanism v) Inversion		5	L1	CO1
	b.	With a neat sketch, explain Elliptical Trammel and also prove that it traces an ellipse.		10	L2	CO1
	c.	Determine the mobility of the linkages shown in Fig.Q.1(c).		5	L2	CO1
 Fig.Q.1(c)						
OR						
Q.2	a.	In a slider crank mechanism, the crank is 200 mm long and connecting rod is 750 mm long. Find analytically i) Velocity and acceleration of the slider. ii) Angular velocity and angular acceleration of connecting rod when the slider has moved 350 mm from top dead centre position. Assume crank rotates at a uniform speed of 400 rpm.		10	L2	CO1
	b.	The crank of a slider crank mechanism is 480 mm long and rotates at 20 rad/sec in the counter clockwise direction. It has a connecting rod of 1600 mm long. Determine the following when the crank is at 60° from the IDC. Determine : i) Velocity of slider ii) Angular velocity of connecting rod iii) Position and velocity of a point on the connecting rod and having least absolute velocity.		10	L3	CO1

Module – 2

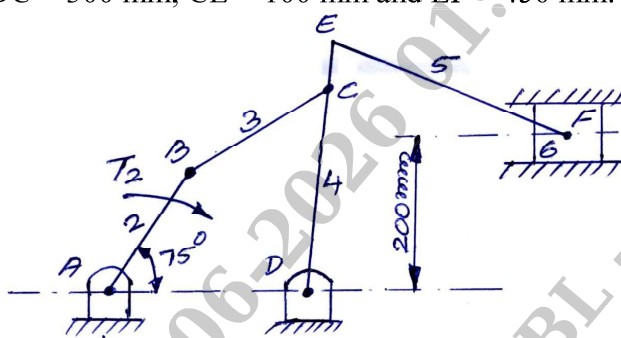
Q.3	a.	State the condition for static equilibrium of a body subjected to i) Two force member ii) Two force member with a torque.	6	L2	CO2
	b.	For the static equilibrium of the mechanism as shown in Fig.Q.3(b). Find the required input torque. The dimensions are $AB = 150$ mm, $BC = AD = 500$ mm, $DC = 300$ mm, $CE = 100$ mm and $EF = 450$ mm. 	14	L3	CO2

Fig.Q.3(b)

OR

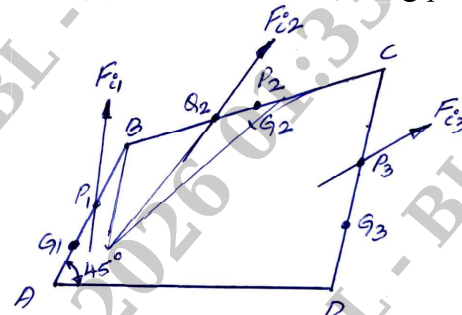
Q.4	a.	State and explain D' Alembert's principle.	5	L2	CO2
	b.	In a four bar linkage ABCD shown in Fig.Q.4(b), the link AB revolves with an angular velocity of 20 rad/sec and angular acceleration of 100 rad/sec ² both in clockwise direction when it makes an angle of 45° with AD. Neglecting gravitational effects, find the torque necessary to overcome inertia forces. The lengths of various links are – $AB = CD = 40$ cm, $BC = 50$ cm, $AD = 75$ cm, the mass of links is 15 kg per meter. 	15	L3	CO2

Fig.Q.4(b)

Module – 3

Q.5	a.	State and prove the law of gearing for constant velocity ratio.	5	L2	CO3
	b.	Two mating spur gear with modular pitch of 6.5 mm have 19 and 47 teeth of 20° pressure angle and 6.5 mm addendum. Determine the number of pairs of teeth in contact and angle turned through by the larger wheel for one pair of teeth in contact. Determine also the sliding velocity at the instant i) Engagement commencer ii) The engagement terminator iii) At the pitch point When the pitch line velocity is 1.2 m/sec.	15	L3	CO3

OR

Q.6	a.	Define Gear train. Explain compound Gear train with a neat sketch.	5	L2	CO3
	b.	An epicyclic gear train consists of a sun wheel (s), a stationary internal gear (E) and 3-identical planet wheels (P) carried on a star shaped planet carrier (C). The size of different toothed wheels are such that the planet carrier C rotates at $1/5$ of the speed of the sun wheel. The minimum number of teeth on any wheel is 16. The driving torque on the sun wheel is 100 N-m. Determine: i) The number of teeth on different wheels of train. ii) Torque necessary to keep the internal gear stationary.	15	L3	CO3

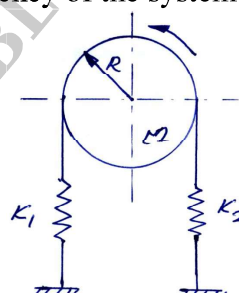
Module – 4

Q.7		A shaft carrier four masses in parallel planer A, B, C and D in this order along its length. The mass at B and C are 18 kg and 12.5 kg respectively and each has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between the masses at B and C is 100° and that between the masses at B and A is 190° , both being measured in the same direction. The axial distance between the planes A and B is 100 mm and that between B and C is 200 mm. If the shaft is in complete dynamic balance, determine: i) The magnitude of the masses at A and D ii) The distance between planes A and D iii) The angular position of the mass D.	20	L3	CO4
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OR

Q.8	a.	Define the following: i) Height of a governor ii) Sleeve lift iii) Sensitiveness iv) Isochronous v) Hunting	10	L2	CO4
	b.	The arms of a porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how speed range is modified.	10	L3	CO4

Module – 5

Q.9	a.	Determine the natural frequency of the system as shown in Fig.Q.9(a).	10	L3	CO5
		 Fig.Q.9(a)			

	b.	The vibrating system of mass weight 70 N, a spring of stiffness 10 N/mm, damping co-efficient 0.036 Ns/mm. Determine : i) Natural frequency of the system ii) Damping factor iii) Ratio of any two successive amplitudes iv) Logarithmic decrement v) Damped natural frequency vi) Periodic time vii) Ratio of peak amplitude after 12 cycles to the peak amplitude in 1 st cycle.	10	L3	CO5
OR					
Q.10	a.	Explain the concept of forced vibration due to rotating unbalance.	10	L2	CO5
	b.	A weight of 60 N suspended by a spring of stiffness 1.2 kN/m is forced to vibrate by a harmonic force of 10 N. Assuming viscous damping of 0.086 KNs/m. Determine : i) The resonant frequency ii) Amplitude at resonance iii) Phase angle at resonance iv) Frequency corresponding to peak amplitude v) Peak amplitude.	10	L3	CO5

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Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026

Energy Engineering

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	What is Forced Circulation? Explain the multiple circuit boiler, with a neat sketch.	8	L2	CO1
	b.	Define cooling tower and explain the principle of hyperbolic cooling tower, with a neat sketch.	8	L2	CO1
	c.	Explain the function of air pre-heater and super heater in thermal power plant.	4	L2	CO1
OR					
Q.2	a.	Draw the layout of a diesel power plant.	6	L1	CO1
	b.	Explain the different methods of starting the diesel engine.	6	L2	CO1
	c.	Explain with neat sketch air intake and exhaust system.	8	L2	CO1
Module – 2					
Q.3	a.	Name solar radiation measuring instruments and explain with a neat sketch the working of pyrheliometer.	10	L2	CO2
	b.	With a neat sketch explain the working of a KVIC digester.	10	L2	CO2
OR					
Q.4	a.	What is the principle of solar photo voltaic power generation? What are the main elements of a PV system?	10	L2	CO2
	b.	Explain the working of downdraft gasifier with a neat sketch.	10	L2	CO2
Module – 3					
Q.5	a.	With a neat sketch, explain the working of hot dry rock geothermal plant.	10	L2	CO3
	b.	With neat sketch explain the working of double basin tidal power plant.	10	L2	CO3
1 of 2					

OR

Q.6	a.	What are the major problems associated with wind power? Explain horizontal axis wind mill with sketch.	10	L2	CO3
	b.	For horizontal axis wind turbine show that the available power $P_a = \frac{1}{8}\pi D^2 V^3 \rho$. Discuss the factors which are influencing on wind power where D = diameter rotor, V = velocity ρ = density of air.	10	L3	CO3

Module – 4

Q.7	a.	Explain with neat sketch the working of hydroelectric power plant and explain the functions of each component in it.	8	L2	CO3
	b.	Discuss the utility of hydrograph, flow duration curve and mass curve for the power plant.	8	L2	CO3
	c.	What are the problems associated with OTEC?	4	L1	CO3

OR

Q.8	a.	Classify Hydro – Electric power plants.	4	L1	CO3
	b.	Explain with a neat sketch Rankine cycle OTEC plant.	8	L2	CO3
	c.	At a particular site the mean discharge (in millions of m ³) of a river in 6 months from January to June are 40, 25, 20, 10, 0 and 50 respectively. Draw the hydrograph and flow duration curve.	8	L3	CO3

Module – 5

Q.9	a.	Explain with a neat diagram various parts of a nuclear reactor, explain clearly the each part.	8	L2	CO3
	b.	With examples, explain the difference between a fissible material and a fertile material.	4	L2	CO3
	c.	Describe construction and working of a pressurized water reactor.	8	L2	CO3

OR

Q.10	a.	Differentiate between BWR and PWR.	4	L2	CO3
	b.	Explain the function of mode rotor, coolant, control rod and shielding in nuclear power plant.	8	L2	CO3
	c.	Describe the different types of fuels used in a nuclear power plant and discuss the problems of nuclear waste disposal.	8	L1	CO3

CBCS SCHEME

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21ME63

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026 Machine Design

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Discuss the use of codes and standards. (04 Marks)
- b. Explain the following theories of failure
 - i) Maximum Normal Stress Theory
 - ii) Maximum Shear Stress Theory
 - iii) Distortion Energy Theory
 (06 Marks)
- c. For the member shown in Fig Q1(c), determine the stress induced at A and B in the member

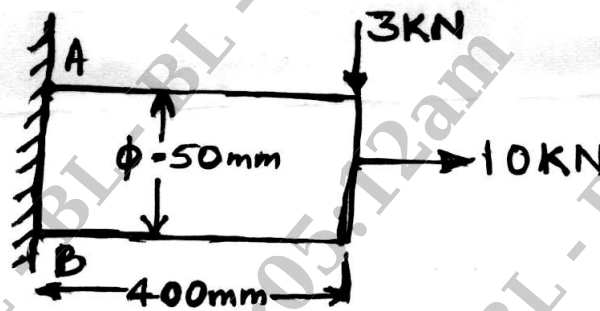


Fig Q1(c)

(10 Marks)

OR

- 2 a. With the help of S-N diagram, explain how low cycle and high cycle fatigue. (04 Marks)
- b. A 500 N weight dropped through a height of 25 mm impacts the centre of a 300 mm long simply supported steel square beam. If the maximum allowable bending stress is 90 MPa, find the dimension of side of the beam and the maximum deflection. Neglect the inertia effect. Take $E = 200$ GPa, (refer Fig Q2(b)).

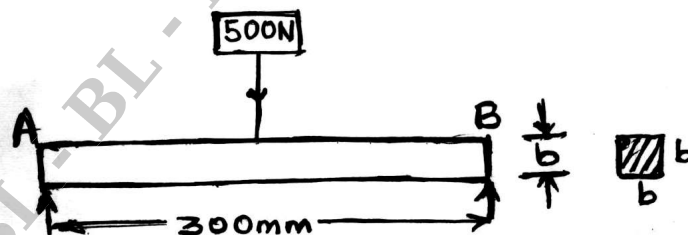


Fig Q2(b)

(16 Marks)

Module-2

- 3 A 45C8 shaft transmitting 15 kW at 210 rpm is supported between two bearings 1000 mm apart. It has two gears, keyed to it. The pinion having 24 teeth and module 6 mm is located 200 mm to the right of left bearing and delivers power to a gear mounted behind it. The gear having 80 teeth of module 6 mm is located 100 mm to the left of the right bearing and receives power from a pinion such that the tangential force acts vertical. Taking combined shock and fatigue factors 1.75 in bending and 1.25 in torsion, determine the shaft diameter. (20 Marks)

OR

- 4 a. Design a flange coupling to connect a shaft of motor and centrifugal pump for the following specification output = 3000 rpm, total head = 20 m, pump speed = 600 rpm, pump efficiency = 70%, C₄₀ steel for shaft and C₃₅ steel for bolt with FOS = 2, use allowable shear stress of casting flange is 15 N/mm². (14 Marks)
- b. List and explain the different types of springs and its materials. (06 Marks)

Module-3

- 5 a. Design a triple riveted lap joint with zig zag riveting for steel plates 20 mm thick using tensile stress $\sigma_t = 90 \text{ N/mm}^2$, Compressive stress $\sigma_c = 120 \text{ N/mm}^2$ and shear stress $\tau = 60 \text{ N/mm}^2$. (12 Marks)
- b. A steel plate 15 mm thick and 50 mm wide is welded to another plate by transverse weld to sustain a tensile load of 25 kN. Determine the length of weld required by taking the permissible stress equal to 110 MPa. When :
- The load is static
 - The load is dynamic
- (08 Marks)

OR

- 6 a. Explain Caulking and fullering with neat sketch. (04 Marks)
- b. A bracket is fixed to the wall by means of four bolts and loaded as shown in Fig Q6(b). Calculate the size of bolts if the load is 10 kN and the design shear stress for bolt material is 40 MPa.

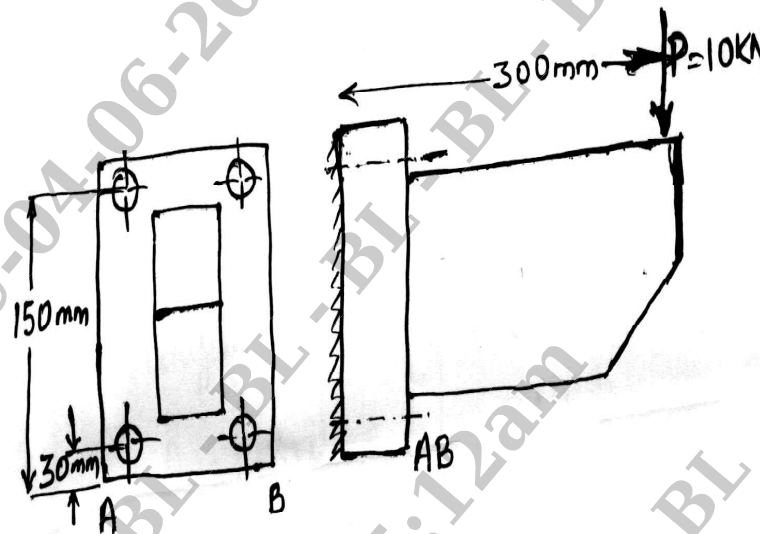


Fig Q6(b)

(16 Marks)

Module-4

- 7 A pair of carefully cut spur gears with 20° full depth involute profiles is used to transmit 12 kW at 1200 rpm of pinion. The gear has to rotate at 300 rpm. The material used for both pinion and gear is medium carbon steel whose allowable bending stress may be taken as 230 MPa. Determine the module and face width. Suggest suitable hardness. Take 24 teeth on pinion and modulus of elasticity as 210 GPa. (20 Marks)

OR

- 8 A pair of helical gears is to transmit 16 kW. The teeth are 20° stub involute, Helix angle is 45° , pinion runs at 10000 rpm and gear at 2500 rpm. The centre distance is to be around 200 mm. The gear are made of cast steel ($\sigma_{d1} = 100$ MPa). Endurance strength = 618 MPa. Determine the module and face width from static strength consideration and check the gear for wear. (20 Marks)

Module-5

- 9 a. A multiple clutch has steel on bronze is transmit 8 kW at 1440 rpm. The inner diameter of contact is 80 mm and outer diameter is 140 mm. The clutch operates in oil with expected coefficient of friction 0.1, the average allowable pressure is 0.35 MPa. Assume uniform wear theory and determine the following :
- i) Number of steel and bronze plate
 - ii) Axial force required
 - iii) Actual Maximum pressure (12 Marks)
- b. A simple band brake of drum diameter of 600 mm has a band passing over it with an angle of contact of 225° , while one end is connected to fulcrum and the other end is connected to the brake lever at a distance of 400 mm from the fulcrum. The brake lever is 1 m long. The brake is to observe a power of 15 kW at 720 rpm. Design the brake lever of rectangular c/s, assuming depth to be thrice the width take allowance stress 80 MPa. (08 Marks)
- OR**
- 10 a. List the assumption and derive the Petroff equation. (10 Marks)
- b. Explain different types of rolling contact bearing and their application. (10 Marks)

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21ME653

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026 Mechatronics

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Briefly explain the evaluation of mechatronics. (05 Marks)
- b. Explain car parking system. (07 Marks)
- c. List the differences between open loop and closed loop feedback system. (08 Marks)

OR

- 2 a. List the various differences between sensors and transducers. (06 Marks)
- b. With the help of diagram explain photodiodes. (06 Marks)
- c. Explain proximity sensors and LVDT. (08 Marks)

Module-2

- 3 a. Explain analog to digital and digital to analog conversion system. (08 Marks)
- b. Explain four methods of signal conditioning. (08 Marks)
- c. With the help of diagrams explain any one filter. (04 Marks)

OR

- 4 a. With the help of diagrams explain working of relay and four types of switches. (10 Marks)
- b. With the help of neat sketch explain DC servomotor. (10 Marks)

Module-3

- 5 a. Define microcontroller. Explain the evaluation of microprocessor. (10 Marks)
- b. With the help of neat sketch explain 8085A microprocessor architecture. (10 Marks)

OR

- 6 a. Explain types of buses and registers. (10 Marks)
- b. Write a short notes on
 - i) Accumulator
 - ii) Program counter
 - iii) Fetch cycle
 - iv) ALU(10 Marks)

Module-4

- 7 a. Define PLC. With the help of symbols explain the components used in ladder logic input and output sides. (10 Marks)
b. With the help of diagram explain conveyor system ladder logic diagram. (10 Marks)

OR

- 8 a. Draw and explain ladder logic diagram for lifting water from the sump to overhead tank using PLC. (10 Marks)
b. What are the criteria's used for selection of PLC? Explain them briefly. (10 Marks)

Module-5

- 9 a. Explain linear motion guideways used in CNC machines. (10 Marks)
b. With the help of diagram, explain recirculating ball screws. (10 Marks)

OR

- 10 a. Explain mechatronics system design process applied for multidisciplinary approach. (10 Marks)
b. Explain with the help of diagram pick and place robot used for material handling in industry. (10 Marks)

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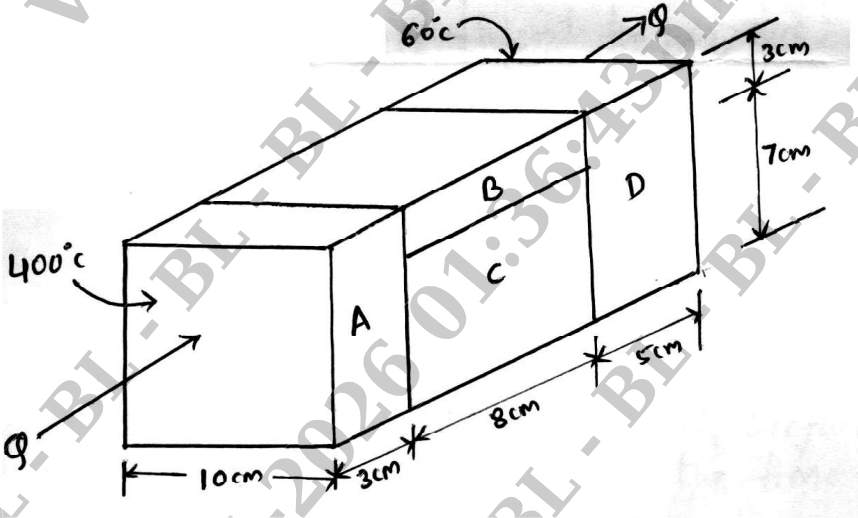
Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026

Heat Transfer

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Explain the three types of boundary conditions in conduction heat transfer with examples.	6	L2	CO1
	b.	Write basic laws governing each mode of heat transfer along with mathematical expression.	6	L1	CO1
	c.	Find the heat flow rate through the composite wall shown in Fig Q1(c). Assume one dimensional conduction. Thermal conductivities of slabs A, B, C and D are 150, 30, 65 and 50 W/m°C respectively.	8	L4	CO1
 Fig Q1(c)					
OR					
Q.2	a.	Derive an expression for the temperature distribution through the plane wall with uniform thermal conductivity. (Assume no energy generation)	6	L3	CO1
	b.	Explain the experimental procedure for determining overall heat transfer coefficient for a composite wall made up of three different materials with suitable sketch tabulation of reading and formulae.	6	L3	CO1

	c.	An iron plate of thickness L with thermal conductivity ' K ' is subjected to a constant uniform heat flux q_0 W/m^2 at the boundary surface at $X = 0$. From the other boundary surface at $X = L$ heat is dissipated by convection in to a fluid at temperature T_∞ with a heat transfer coefficient ' h '. Develop expression for the determination of the surface temperature T_1 and T_2 at the surface $X = 0$ and $X = L$ respectively. Calculate surface temperature T_1 and T_2 for $L = 2$ cm, $K = 20$ $\text{W/m } ^\circ\text{C}$, $q_0 = 10^5$ W/m^2 , $T_\infty = 50^\circ\text{C}$, $h = 500$ $\text{W/m}^2 ^\circ\text{C}$	8	L4	CO1
Module – 2					
Q.3	a.	With usual notations derive an expression for temperature distribution for Fin with insulated tip state the assumption made.	10	L3	CO3
	b.	Handle of a spoon has rectangular cross – section $5 \text{ mm} \times 2 \text{ mm}$. Find length required so that its end temperature will not exceed 25°C even when spoon is dipped in boiling water for a long time. Assume long fin. Take $K = 39$ $\text{W/m } ^\circ\text{C}$, $h = 10$ $\text{W/m}^2 ^\circ\text{C}$, $T_\infty = 20^\circ\text{C}$ (Ambient temperature)	10	L4	CO3
OR					
Q.4	a.	With usual notations derive an expression for the temperature distribution through a body for lumped parameter analysis in terms of Biot number and Fourier number.	10	L3	CO3
	b.	A $50 \text{ cm} \times 50 \text{ cm}$ copper slab, 6 mm thick, at uniform temperature of 350°C , suddenly has its surface temperature lowered to 30°C . Find the time at which the slab temperature becomes 100°C . Given : $\rho = 9000$ Kg/m^3 , $C_p = 0.38$ kJ/Kg K , $K = 370$ W/mK , $h = 100$ $\text{W/m}^2 \text{ K}$. Find out the rate of cooling after 60 seconds.	10	L4	CO3
Module – 3					
Q.5	a.	Explain the finite difference formulation of one dimensional steady state conduction for a plane wall using energy balance approach.	10	L3	CO1

	b.	A large plate of thickness $L = 4$ cm having thermal conductivity $K = 28$ W/m°C in which heat is generated uniformly at a constant rate of $q_{gm} = 5 \times 10^6$ W/m ³ . One end of the plate is maintained at 0°C and other end is subjected to environment at $T_\infty = 30^\circ\text{C}$, with heat transfer coefficient of $h = 45$ W/m ² °C. Considering three nodes as two nodes at the boundary and one in the middle. Determine the surface temperature of the plate for steady state conditions using finite difference approach.	10	L4	CO1
OR					
Q.6	a.	Explain the following : i) Stefan Boltzmann law ii) Kirchhoff's law iii) Wein's displacement law	6	L2	CO3
	b.	Explain the following : i) Absorptivity ii) Reflectivity iii) Transmissivity	6	L2	CO3
	c.	A long pipe 50 mm in diameter passes through a room and is exposed to air at 20°C . Pipe surface temperature is 93°C . Emissivity of the surface is 0.6. Calculate the net radiant heat loss per meter length of pipe.	8	L4	CO3
Module – 4					
Q.7	a.	Explain with sketch development of velocity boundary layer and thermal boundary layer over a smooth flat plate.	10	L3	CO2
	b.	Dry air at atmospheric pressure and 20°C is flowing with a velocity of 3 m/s along the length of a long, flat plate 0.3 m wide maintained at 100°C . Calculate the following quantities at $X = 0.3$ m i) Boundary layer thickness ii) Local friction coefficient iii) Thickness of thermal boundary layer	10	L4	CO2
OR					
Q.8	a.	Define the following Dimensionless parameters i) Nusselt number ii) Prandtl number iii) Reynold number iv) Stanton number v) Grashoff number	10	L1	CO2

	b.	Calculate the total heat loss from a human body, assuming as vertical cylinder, 30 cm in diameter and 175 cm in height stand in still air at 13°C. Take the skin temperature as 37°C and emissivity as 0.4.	10	L4	CO2
Module – 5					
Q.9	a.	Explain the different regimes of boiling curves of water.	10	L4	CO4
	b.	Saturated steam at $T_{\text{sat}} = 90^\circ\text{C}$ ($P = 70.14 \text{ KPa}$) condenses on the outer surface of a 1.5 m long 2.5 m outer diameter, vertical tube maintained at a uniform temperature $T_\infty = 70^\circ\text{C}$. Assume film condensation. Calculate : i) Local heat transfer coefficient at the bottom of tube ii) Average heat transfer coefficient over the entire length of the tube.	10	L3	CO4
OR					
Q.10	a.	Derive an expression for Logarithmic Mean Temperature Difference (LMTD) for counter flow heat exchanger. State the assumption made.	10	L3	CO4
	b.	Engine oil is to be cooled from 80 °C to 50 °C by using a single pass counter flow concentric tube heat exchanger with cooling water available at 20 °C. Water flows inside a tube with an inner diameter of 2.5 cm at a rate of $M_w = 0.08 \text{ Kg/s}$ and oil flows through the annulus at a rate of $M_{\text{oil}} = 0.16 \text{ Kg/s}$. The heat transfer coefficient for the water side and oil side are $h_w = 1000 \text{ W/m}^2 \text{ }^\circ\text{C}$, $h_{\text{oil}} = 80 \text{ W/m}^2 \text{ }^\circ\text{C}$. The fouling factor are $F_w = 0.00018 \text{ m}^2 \text{ }^\circ\text{C/W}$ and $F_{\text{oil}} = 0.00018 \text{ m}^2 \text{ }^\circ\text{C/W}$, Tube wall resistance is negligible. Calculate the tube length required. $C_w = 4180 \text{ J/Kg }^\circ\text{C}$, $C_{\text{oil}} = 2090 \text{ J/Kg }^\circ\text{C}$	10	L4	CO4

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026

Machine Design

Time: 3 hrs.

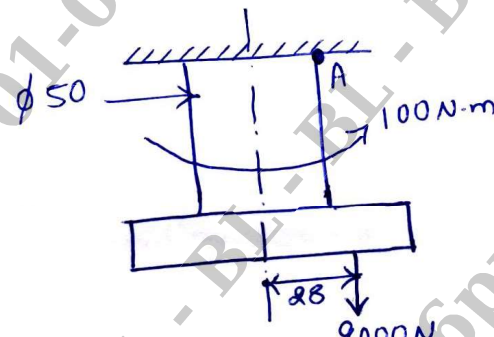
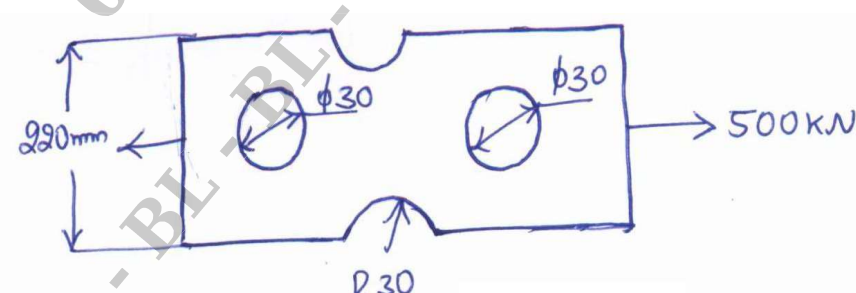
Max. Marks: 100

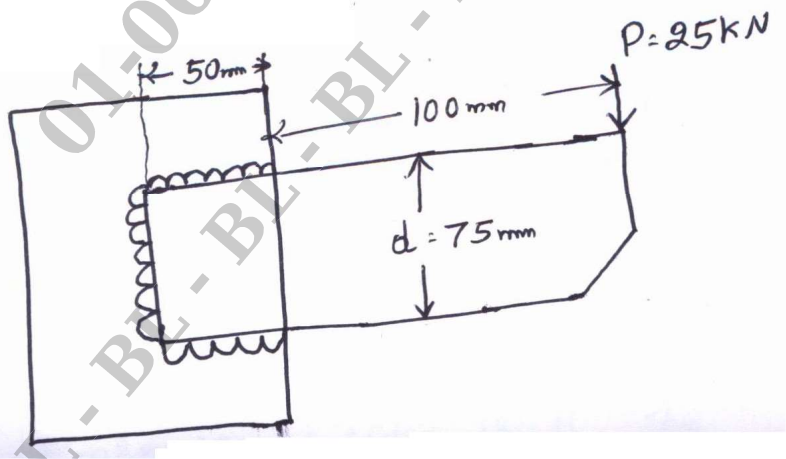
Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. M : Marks , L: Bloom's level , C: Course outcomes.

3. Use of machine design data hand book is permitted.

4. Assume any missing data suitably.

Module – 1				M	L	C
Q.1	a.	A 50 mm diameter steel rod supports a 9.0 kN load and in addition is subjected to a torsional moment of 100 N.m as shown in Fig. Q1 (a). Determine the maximum tensile and the maximum shear stress.  Fig. Q1 (a)	10	L3	CO1	
	b.	A rod of circular section is to sustain a torsional moment of 300 kN.m and bending moment 200 kN-m. Selecting C45 steel ($\sigma_y = 353$ MPa) and assuming factor of safety = 3, determine the diameter of rod as per the following theories of failure : (i) Maximum shear stress theory. (ii) Distortion Energy Theory. (iii) Total Energy Theory.	10	L3	CO1	
OR						
Q.2	a.	A bar of rectangular section is subjected to an axial pull of 500 kN. Calculate its thickness if the allowable tensile stress in the bar is 200 MPa. Refer Fig. Q2 (a).  Fig. Q2 (a)	12	L3	CO1	

	b.	Derive Soderburg's equation when a member is subjected to fatigue axial loading.	8	L2	CO1
Module – 2					
Q.3		A shaft is supported by two bearings placed 1 m apart. A 500 mm diameter pulley is mounted at a distance of 200 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 3000 N. The pulley weighs 10000 N. Another pulley 300 mm diameter is placed 300 mm to the left of right hand bearing is driven with the help of electric motor and the belt which is placed horizontally to the right when viewed from the left bearing. This pulley weighs 500 N. The angle of contact for both the pulleys is 180° and $\mu = 0.24$. Determine suitable diameter for a solid shaft assuming torque on one pulley is equal to torque on other pulley. Choose C15 steel ($\sigma_y = 235.4$ MPa take $\sigma_u = 425$ MPa) as the shaft material and use ASME code for the design of shaft. Assume minor shock condition.	20	L3	CO2
OR					
Q.4	a.	What are the types of keys and give application?	6	L1	CO3
	b.	Design a protected type cast iron flange coupling for a steel shaft transmitting 30 K at 200 rpm. The allowable shear stress in the shaft and key material is 40 MPa. The maximum torque transmitted to be 20% greater than the full load torque. The allowable shear stress in the bolt is 60 MPa and the allowable shear stress in the flange is 40 MPa.	14	L3	CO3
Module – 3					
Q.5	a.	A double riveted lap joint is to be made between 9 mm plates. If the safe working stresses in tension, crushing and shear are 80 N/mm^2 , 120 N/mm^2 and 60 N/mm^2 respectively, design the riveted joint.	10	L3	CO3
	b.	Determine the size of weld required for an eccentrically loaded weld as shown in Fig. Q5 (b). The allowable stress in the weld is 75 N/mm^2 . 	10	L3	CO3
Fig. Q5 (b)					

OR

Q.6		A pair of high grade cast iron with 20° full depth teeth transmits 8 kW at 900 rpm of pinion. The transmission ratio desired is 4 and number of teeth on the pinion is 20. Design the gear based on strength.	20	L3	CO3
Module – 4					
Q.7		A vertical drilling machine requires a set of bevel gear to reduce the speed from 2500 rpm to 1250 rpm at the spindle. Design the bevel gear drive with 20° full depth teeth for a power to be transmitted is to be 20 kW. Select proper material. Pinion – SAE 1030 Heat treated Gear – Cast steel Heat treated Design and check wear.	20	L3	CO4
OR					
Q.8	a.	Define Warm Gear and how it works. Write the applications.	6	L1	CO4
	b.	Design a worm gear drive consists of hardened steel worm and phosphour bronze gear have 20° stub involute teeth and transmission ratio is 10. The worm speed is 2000 rpm and transmits a power of 12 kW with a centre distance is to be 200 mm.	14	L3	CO4
Module – 5					
Q.9	a.	Determine the power transmitted by a single pair plate clutch assuming uniform pressure distribution. The friction surfaces have an outside diameter of 350 mm and an inner diameter of 280 mm. The co-efficient of friction is 0.25 and the maximum allowable pressure is 0.85 MPa.	10	L3	CO3
	b.	Fig. Q9 (b) shows a single block brake. The brake drum diameter is 400 mm and rotates at a speed of 150 rpm. The friction material permits a maximum pressure of 0.5 MPa and $\mu = 0.25$. Face width of the block is 50 mm. If the brake is applied for 10 secs at full capacity to bring the shaft to stop. Determine : (i) Effort (ii) Maximum torque (iii) Heat generated	10	L3	CO3

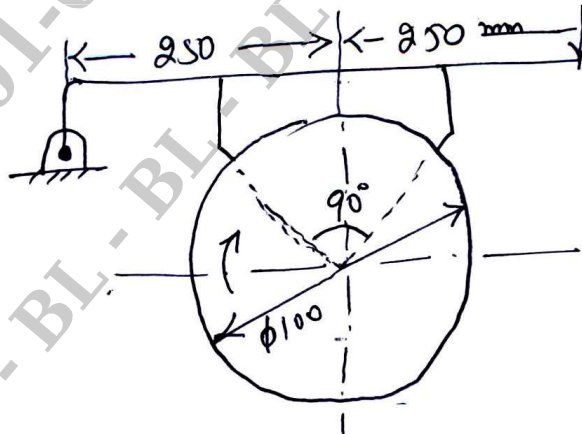


Fig. Q9 (b)

OR					
Q.10	a.	Derive Petroff's Equation.	10	L2	CO5
	b.	A full journal bearing has a diameter of 45 mm and length 65 mm that diametral clearance ratio is 0.0015, the speed of the shaft is 3000 rpm and radial load is 900 N. The oil used has a viscosity of 0.01 Pa-S at its operating temperature. Determine (i) Co-efficient of friction (ii) Power loss (iii) Frictional torque (iv) Sommer field number.	10	L3	CO5

CBCS SCHEME

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BME613A

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026 Total Quality Management

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Determine quality, interpret how quality plays an important role in improving productivity of a company.	10	L3	CO1
	b.	Investigate the TQM framework with a block diagram.	10	L3	CO1
OR					
Q.2	a.	Demonstrate the various requirements of ISO 9001 series with block diagram.	10	L3	CO1
	b.	Make a list of basic concepts of TQM and brief them.	10	L3	CO1
Module – 2					
Q.3	a.	Explain the dimension of quality and illustrate the role of quality leaders.	10	L3	CO2
	b.	Examine out Deming's 14 points of TQM philosophy and explain them.	10	L3	CO2
OR					
Q.4	a.	Construct different ways in which quality leaders can help the organization to improve quality.	10	L2	CO2
	b.	Examine out the 12 characteristics of quality leaders. Describe them.	10	L3	CO2
Module – 3					
Q.5	a.	Determine customer perception of quality and needs of quality.	10	L3	CO3
	b.	Elucidate on translating needs into requirements with suitable example.	10	L3	CO3
OR					
Q.6	a.	Examine the employee survey and recognition and reward of an employee.	10	L3	CO3
	b.	Demonstrate how performance appraisal helps the employee in developing the organization.	10	L3	CO3
1 of 2					

Module – 4

Q.7	a.	Demonstrate Juran's Trilogy with neat sketch and explain them.	10	L3	CO4
	b.	Explain PDSA cycle for continuous improvement with a neat figure.	10	L3	CO4

OR

Q.8	a.	Explicate on scatter diagram and cause and effect diagram with a neat diagram.	10	L3	CO4
	b.	Enlighten on Histogram, Pareto diagram with a sketch and evidences.	10	L3	CO4

Module – 5

Q.9	a.	Which are the 08 Pillars of TPM? Describe them with a neat sketch.	10	L3	CO4
	b.	List and mention importance of 5's and discuss them.	10	L3	CO4

OR

Q.10	a.	Lean out steps involved in introduction of TPM.	10	L3	CO4
	b.	Determine Qb_D and explain the role of Qb_D in Pharmaceutical industry with its benefits.	10	L3	CO4

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BME654A

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026 Project Management

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Define Project. Briefly explain the characteristics of project.	10	L2	CO1
	b.	Discuss the different knowledge areas identified by PMBOK.	10	L2	CO1
OR					
Q.2	a.	Briefly explain the scalability of project tools.	10	L2	CO1
	b.	Briefly explain the strategic analysis.	10	L2	CO1
Module – 2					
Q.3	a.	Briefly explain the steps in defining the project scope.	10	L2	CO2
	b.	Explain in detail Work Breakdown Structure (WBC).	10	L2	CO2
OR					
Q.4	a.	Briefly explain different types of uncertainty in project schedules.	10	L2	CO2
	b.	Explain Gant chart.	5	L2	CO2
	c.	Briefly explain purpose of a project schedule.	5	L2	CO2
Module – 3					
Q.5	a.	Briefly explain : i) Cost planning ii) Cost estimating iii) Cost budgeting.	10	L2	CO3
	b.	Explain the abilities needed while resourcing projects.	10	L2	CO3
1 of 2					

OR

Q.6	a.	Briefly explain the risk identification and risk response planning.	10	L2	CO3
	b.	Briefly explain project quality planning and project kick off in detail.	10	L2	CO3

Module – 4

Q.7	a.	Define Project Supply Chain Management. Explain Plan Purchasing and acquisitions.	6	L2	CO4
	b.	Briefly explain project partnering and collaborations.	8	L2	CO4
	c.	Briefly explain different types of project procurement contracts.	6	L2	CO4

OR

Q.8	a.	Explain the common reasons for terminating the project early.	10	L2	CO4
	b.	Briefly explain Balanced score card approach.	10	L2	CO4

Module – 5

Q.9	a.	Briefly explain the rules of network construction.	8	L2	CO5
	b.	Write a note on AOA and AON diagrams.	6	L1	CO5
	c.	Explain Fulkerson's rule for numbering the events in network diagram.	6	L2	CO5

OR

Q.10	a.	Briefly explain the PERT and CPM.	10	L2	CO5
	b.	Discuss the common errors in drawing networks.	10	L2	CO5

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Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026

Renewable Energy Power Plants

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: Bloom's level, C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Explain briefly different renewable and non-renewable energy sources.	10	L2	CO1
	b.	Differentiate between beam radiation, diffuse radiation and global radiation. How do these types of radiation impact solar energy systems?	10	L2	CO1
OR					
Q.2	a.	How does global energy demand vary across different regions of the world? Explain briefly with in detail information of each country.	10	L2	CO1
	b.	Define solar constant and discuss its significance in the study of solar energy. How does it affect solar power generation?	10	L2	CO1
Module – 2					
Q.3	a.	Compare and contrast the different types of solar power plants: grid-tied, off-grid and hybrid systems. Discuss their advantages and disadvantages.	10	L2	CO2
	b.	Describe the process of solar thermal conversion and compare it with photovoltaic energy conversion. Which applications are best suited for each method?	10	L2	CO2
OR					
Q.4	a.	With help neat sketch describe solar distillation system and solar flat plate collector.	10	L2	CO2
	b.	With the help of neat sketch, enumerate the concept behind the solar pond and solar chimney.	10	L2	CO2
Module – 3					
Q.5	a.	Describe the methodology involved in wind resource assessment. What are the major factors considered when selecting a wind power plant site?	10	L2	CO3
	b.	With the help of neat schematic diagram, explain the three main types of geothermal power stations: dry steam, flash steam and binary cycle plants.	10	L2	CO3
1 of 2					

OR

Q.6	a.	Explain the challenges and considerations involved in the grid integration of wind power. How does wind variability affect power system stability?	10	L2	CO3
	b.	What are the main problems associated with geothermal energy conversion? Discuss issues related to environmental impact, resource depletion and technical challenges.	10	L2	CO3

Module – 4

Q.7	a.	Describe the fundamental characteristics of tidal power. What are the main parameters that affect tidal energy generation?	10	L2	CO4
	b.	With the help of a schematic diagram. Explain the working principle of a tidal power plant. Mention the different types of tidal power systems.	10	L2	CO4

OR

Q.8	a.	Explain the principle of operation of OTEC systems. How does the temperature difference in ocean layers enable power generation?	10	L2	CO4
	b.	Discuss the technical and environmental problems, associated with OTEC. How do these challenges impact the large scale deployment of OTEC systems?	10	L2	CO4

Module – 5

Q.9	a.	Define a biogas plant and list and explain the Key Operational parameters that affect its performance.	10	L2	CO5
	b.	Describe the structure and working of a floating drum (constant pressure) biogas plant.	10	L2	CO5

OR

Q.10	a.	Explain the process of electrolysis of water for hydrogen production. Include a labeled diagram.	10	L2	CO5
	b.	Discuss the safety issues associated with the production, storage and transportation of Hydrogen.	10	L2	CO5

CBCS SCHEME

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BME654C

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2026

Introduction to Mechatronics

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Define Mechatronics. Explain the basic elements of mechatronic system.	10	L2	CO1
	b.	Explain the working and functionality of automatic car parking system.	10	L2	CO1
OR					
Q.2	a.	Differentiate between open-loop and closed-loop control system with block diagram.	10	L2	CO1
	b.	Explain potentiometers and LVDT.	10	L2	CO1
Module – 2					
Q.3	a.	Explain filtering with R-C circuit.	10	L2	CO2
	b.	Discuss the construction and operation of stepper motor.	10	L2	CO2
OR					
Q.4	a.	Discuss digital signal processing and its role in digital to analog conversion.	10	L2	CO2
	b.	Explain the working principle of relays and solenoids.	10	L2	CO2
Module – 3					
Q.5	a.	Explain the architecture of 8085A microprocessor.	12	L2	CO3
	b.	Compare Micro Controllers and Micro Processors.	8	L2	CO3

OR

Q.6	a.	Explain : i) Fetch cycle ii) Write cycle	10	L2	CO3
	b.	Explain the pin configuration of 8085A microprocessor.	10	L2	CO3

Module – 4

Q.7	a.	Discuss : i) PLC Programming Language ii) Ladder diagram	10	L2	CO1
	b.	Explain basic structure of PLC.	10	L2	CO1

OR

Q.8	a.	Explain the operation of pneumatic piston using latches.	10	L2	CO1
	b.	Explain the control of process motor using PLC.	10	L2	CO1

Module – 5

Q.9	a.	Explain the design of modern CNC machine.	10	L2	CO5
	b.	Explain the working principle of hydrostatic and hydrodynamic bearings.	10	L2	CO5

OR

Q.10	a.	Explain the mechatronic design process.	10	L2	CO5
	b.	Discuss case study of pick and place robot in mechatronic system.	10	L2	CO5

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21ME72

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026 Control Engineering

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

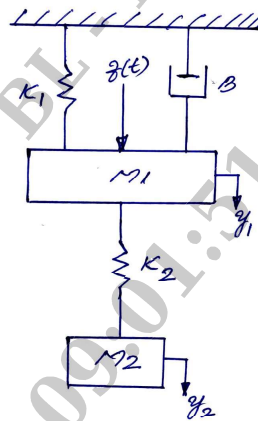
Module-1

- 1 a. Distinguish between Open loop and Closed loop systems. (05 Marks)
- b. List the types of controllers and explain PID controller with block diagram. (09 Marks)
- c. List and explain requirements of an ideal control system. (06 Marks)

OR

- 2 a. Obtain the transfer function for an Armature Controlled DC - motor. (10 Marks)
- b. Obtain the transfer function for the mechanical system shown in Fig. Q2(b). (10 Marks)

Fig. Q2(b)



Module-2

- 3 a. Explain typical test signals in control system. (08 Marks)
- b. Develop an expression for steady state error for a simple closed loop control system. (08 Marks)
- c. Explain the importance of response analysis of control system. (04 Marks)

OR

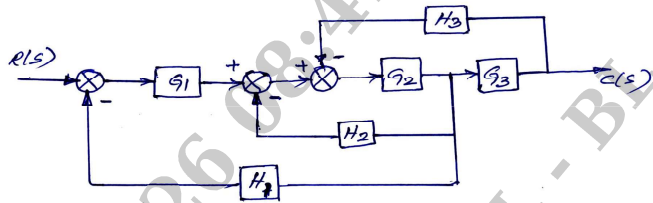
- 4 a. Examine a second order under damped system subjected to unit step input. (10 Marks)
- b. A unity feedback control system is characterized by an open loop transfer function $G(s)H(s) = \frac{K}{s(s+10)}$. Determine the system gain K, so that the system will have a damping ratio of 0.5. For this value of K. Find the rise time, settling time and peak overshoot for a unit step input. (10 Marks)

Module-3

- 5 a. Explain the block diagram reduction rules to obtain system transfer function. (05 Marks)

- b. Obtain the overall transfer function $\frac{C(s)}{R(s)}$ using block diagram reduction technique for the Fig. Q5(b). (15 Marks)

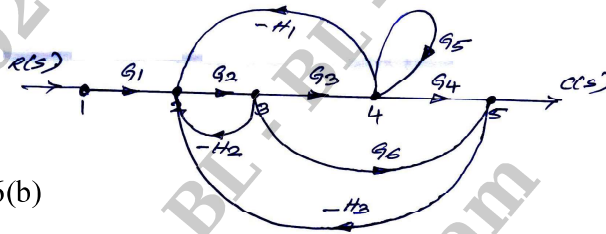
Fig. Q5(b)



OR

- 6 a. Explain the terms : i) Node ii) Input node iii) Branch
iv) Path v) Loop. (05 Marks)
b. Find the overall transfer function by using Mason's gain formula for the signal flow graph shown in Fig. Q6(b). (15 Marks)

Fig. Q6(b)

**Module-4**

- 7 a. The characteristic equation of a system, is given by $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$. Determine the stability using RH criteria. (06 Marks)
b. Sketch the root locus plot of a unity feedback with an open loop transfer function $G(s) = \frac{K}{s(s+2)(s+4)}$. Find the value of 'K' for stable. (14 Marks)

OR

- 8 Sketch the root locus plot for the system whose open loop transfer function is given by

$$G(s)H(s) = \frac{K}{s(s+2)(s^2+8s+20)} \quad (20 \text{ Marks})$$

Module-5

- 9 Draw the Nyquist plot for

$$G(s)H(s) = \frac{K}{s^4 + 8s^3 + 17s^2 + 10s} \quad \text{and find the value of K.} \quad (20 \text{ Marks})$$

OR

- 10 Construct the Bode plot on a semi-log graph paper for a unity feedback system, whose open loop transfer function is given by

$$G(s)H(s) = \frac{10}{s(1+s)(1+0.02s)} \quad \text{From the Bode plot, determine}$$

- a. Gain and phase cross over frequencies
b. Gain and phase margin.
c. Stability of the closed loop system. (20 Marks)

CBCS SCHEME

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21ME753

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026 Operations Research

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks, L: Bloom's level, C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Define OR. Explain the different phases of OR.	10	L1	CO1
	b.	A firm manufactures two types of products A and B and sells them at a profit of Rs.2 on any type A and Rs.3 on any type B. Each product is processed on two machines G and H. Type A requires 1 minute of processing time on G and two minutes on H. Type B requires 1 minute on G and one minute on H. The machine G is available for not more than 400 minutes while machine H is available for 600 minutes during any working day. Formulate the problem as LPP.	10	L3	CO1
OR					
Q.2	a.	Explain the different applications of OR.	10	L1	CO1
	b.	Solve graphically the following LPP: Min $Z = 10x_1 + 4x_2$ Subject to $3x_1 + 2x_2 \geq 60$ $7x_1 + 2x_2 \geq 84$ $3x_1 + 6x_2 \geq 72$ and $x_1, x_2 \geq 0$	10	L2	CO1
Module – 2					
Q.3	a.	Define slack, surplus and artificial variables.	6	L1	CO2
	b.	Solve the following LPP by simplex method Max $Z = 3x_1 + 2x_2$ Subject to $x_1 + x_2 \leq 4$ $x_1 - x_2 \leq 2$ and $x_1, x_2 \geq 0$	14	L2	CO2
OR					
Q.4		Solve the following LPP by using Big-M method Max $Z = -2x_1 - x_2$ Subject to $3x_1 + x_2 = 3$, $4x_1 + 3x_2 \geq 6$ $x_1 + 2x_2 \leq 4$ and $x_1, x_2 \geq 0$	20	L2	CO2

Module – 3

Q.5	a.	Define Transportation problem.	2	L1	CO3																														
	b.	Determine the optimum solution to the following transportation problem. <table border="1" data-bbox="488 398 1043 591"> <tr> <th></th><th>D₁</th><th>D₂</th><th>D₃</th><th>D₄</th><th>Available</th></tr> <tr> <td>O₁</td><td>1</td><td>3</td><td>1</td><td>4</td><td>30</td></tr> <tr> <td>O₂</td><td>3</td><td>3</td><td>2</td><td>1</td><td>50</td></tr> <tr> <td>O₃</td><td>4</td><td>2</td><td>5</td><td>9</td><td>20</td></tr> <tr> <td>Required</td><td>20</td><td>40</td><td>30</td><td>10</td><td></td></tr> </table>		D ₁	D ₂	D ₃	D ₄	Available	O ₁	1	3	1	4	30	O ₂	3	3	2	1	50	O ₃	4	2	5	9	20	Required	20	40	30	10		18	L2	CO3
	D ₁	D ₂	D ₃	D ₄	Available																														
O ₁	1	3	1	4	30																														
O ₂	3	3	2	1	50																														
O ₃	4	2	5	9	20																														
Required	20	40	30	10																															

OR

Q.6	a.	Differentiate between Transportation and Assignment problem.	8	L1	CO3																									
	b.	Solve the following assignment problem : <table><tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>I</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>II</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>III</td><td>7</td><td>8</td><td>9</td><td>8</td></tr><tr><td>IV</td><td>3</td><td>5</td><td>8</td><td>4</td></tr></table>		1	2	3	4	I	2	3	4	5	II	4	5	6	7	III	7	8	9	8	IV	3	5	8	4	12	L2	CO3
	1	2	3	4																										
I	2	3	4	5																										
II	4	5	6	7																										
III	7	8	9	8																										
IV	3	5	8	4																										

Module – 4

Q.7	a.	Define : i) Activity ii) Event iii) Total float iv) Free float	8	L1	CO4																										
	b.	A project has the following time schedule : <table><tr><td>Activity</td><td>1-2</td><td>1-3</td><td>1-4</td><td>2-5</td><td>3-6</td><td>3-7</td></tr><tr><td>Duration</td><td>2</td><td>2</td><td>1</td><td>4</td><td>8</td><td>5</td></tr></table> <table><tr><td>Activity</td><td>4-6</td><td>5-8</td><td>6-9</td><td>7-8</td><td>8-9</td></tr><tr><td>Duration</td><td>3</td><td>1</td><td>5</td><td>4</td><td>3</td></tr></table> Construct the network and compute i) Total float for each activity ii) Critical path and its duration	Activity	1-2	1-3	1-4	2-5	3-6	3-7	Duration	2	2	1	4	8	5	Activity	4-6	5-8	6-9	7-8	8-9	Duration	3	1	5	4	3	12	L3	CO4
Activity	1-2	1-3	1-4	2-5	3-6	3-7																									
Duration	2	2	1	4	8	5																									
Activity	4-6	5-8	6-9	7-8	8-9																										
Duration	3	1	5	4	3																										

OR

Q.8	a.	Explain the characteristics of queuing model.	8	L2	CO4
	b.	In a hair dress saloon with one barber, the customer arrival follows poisson distribution at an average rate of one every 45 minutes the service time is exponentially distributed with a mean of 30 minutes Find: i) Average number of customers in saloon ii) Average waiting time of customer before service iii) Average idle time of barber iv) Probability that the customer has to wait for service v) Average number of customer in que	12	L3	CO4

Module – 5

Q.9	a.	Define: i) Two person zero sum game ii) Fair game iii) Saddle point iv) Value of game	8	L1	CO5																		
	b.	Solve graphically the following game whose pay off matrix for the player 'A' is A <table><tr><td></td><td colspan="2">B</td></tr><tr><td></td><td>I</td><td>II</td></tr><tr><td>I</td><td>2</td><td>4</td></tr><tr><td>II</td><td>2</td><td>3</td></tr><tr><td>III</td><td>3</td><td>2</td></tr><tr><td>IV</td><td>-2</td><td>6</td></tr></table>		B			I	II	I	2	4	II	2	3	III	3	2	IV	-2	6	12	L3	CO5
	B																						
	I	II																					
I	2	4																					
II	2	3																					
III	3	2																					
IV	-2	6																					

OR

Q.10	a.	Define sequencing problem. What are the assumption made while solving sequencing problem.	8	L1	CO5																								
	b.	There are five jobs each of which must go through machines A and B in the order AB. Processing times are given below: <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td><th colspan="5">Processing time in hours</th></tr> <tr> <th>Job</th><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr> <th>Time for A</th><td>5</td><td>1</td><td>9</td><td>3</td><td>10</td></tr> <tr> <th>Time for B</th><td>2</td><td>6</td><td>7</td><td>8</td><td>4</td></tr> </table> Determine total elapsed time and idle time for the machines.		Processing time in hours					Job	1	2	3	4	5	Time for A	5	1	9	3	10	Time for B	2	6	7	8	4	12	L3	CO5
	Processing time in hours																												
Job	1	2	3	4	5																								
Time for A	5	1	9	3	10																								
Time for B	2	6	7	8	4																								

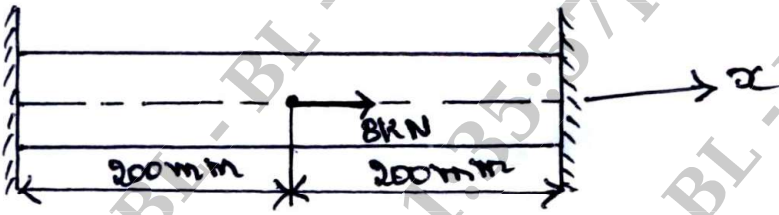
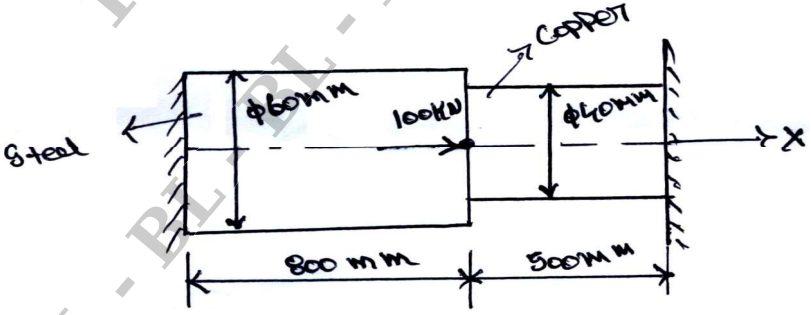
Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026

Finite Element Method

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1				M	L	C
Q.1	a.	Explain the steps involved in FEM.		8	L1	CO1
	b.	Explain plane stress and plane strain condition.		8	L1	CO1
	c.	Write the strain displacement equations for a 3D electric body.		4	L2	CO1
OR						
Q.2	a.	Explain principle of minimum potential energy.		5	L2	CO1
	b.	Use Rayleigh-Ritz Method to find stress and displacement at the mid point of a bar shown in Fig.Q.2(b). Take $E = 70 \text{ GPa}$, $A = 100 \text{ mm}^2$. Assume the displacement model to be a 2 nd order polynomial.		15	L3	CO1
 Fig.Q.2(b)						
Module – 2						
Q.3	a.	Derive shape function for triangular (CST) element in natural coordinate system.		8	L2	CO2
	b.	For the axially loaded bar shown in Fig.Q.3(b). Determine : i) Nodal Displacements ii) Element stress. Take $E_{\text{steel}} = 200 \text{ GPa}$, $E_{\text{cu}} = 100 \text{ GPa}$.		12	L3	CO2
 Fig.Q.3(b)						

OR

Q.4	a.	Derive stiffness matrix for a 1D bar element using the principle of minimum potential energy.	8	L3	CO2
	b.	For the bar shown in Fig.Q.4(b), an axial load $P = 60 \times 10^3$ N is applied at its midpoint using penalty method of handling boundary conditions determine the nodal displacements and support reactions.	12	L2	CO2

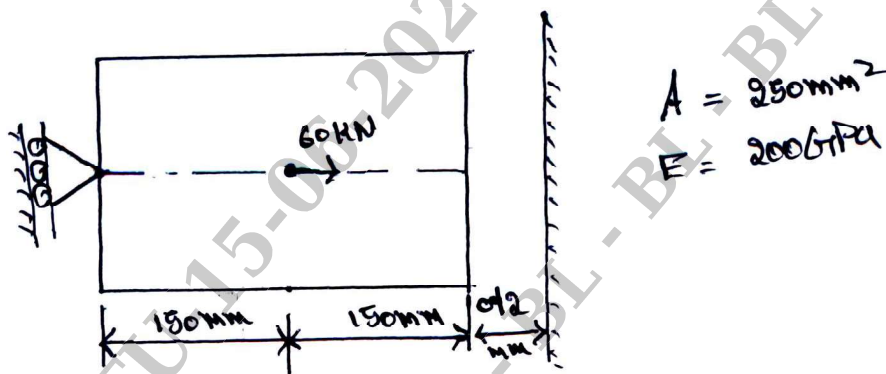


Fig.Q.4(b)

Module – 3

Q.5	a.	Define Plane Truss and list the assumptions made in analysis of truss element.	5	L1	CO3
	b.	For the two bar truss shown in Fig.Q.5(b), find the nodal displacements, stress and support reactions. Take $E = 200$ GPa.	15	L3	CO3

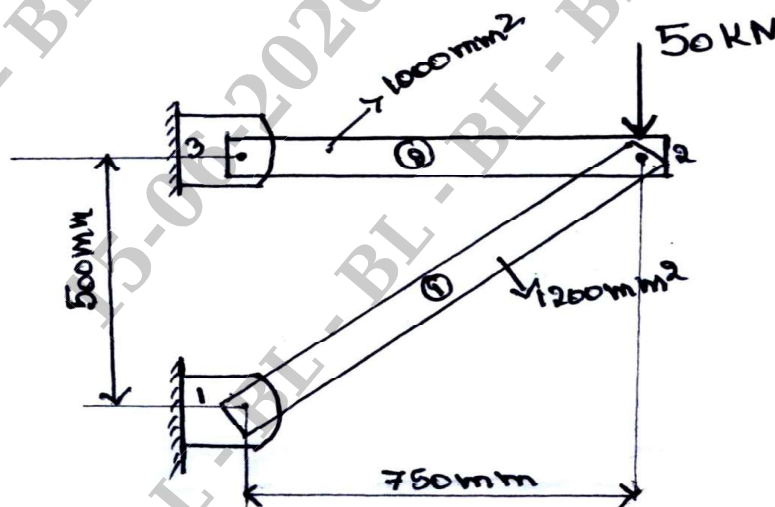


Fig.Q.5(b)

OR

Q.6	a.	Derive the Hermite shape functions for a beam element.	10	L3	CO3
	b.	For the beam shown in Fig.Q.6(b) determine the slopes at 2 and 3. Also determine the vertical deflection at the mid points of the distributed load. Take $E = 200 \text{ GPa}$, $I = 4 \times 10^6 \text{ mm}^4$.	10	L2	CO3

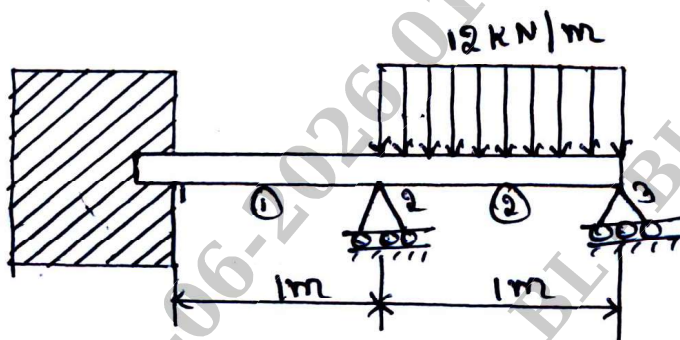


Fig.Q.6(b)

Module – 4

Q.7	a.	Write a short note on the following: i) Simplex, complex and multiplex elements ii) 2D Pascal Triangle	10	L1	CO4
	b.	Derive shape function for 2 nd order bar element in natural coordinates.	10	L2	CO4

OR

Q.8	a.	Briefly explain ISO Parametric, Sub parametric and Super parametric elements.	10	L2	CO4
	b.	Derive shapes function for a 2D quadrilateral element using natural coordinate system.	10	L3	CO4

Module – 5

Q.9		For the stepped bar shown in Fig.Q.9, determine the Eigen values and Eigen vectors. Take $A_1 = 400 \text{ mm}^2$, $A_2 = 200 \text{ mm}^2$, $\rho = 7850 \text{ kg/m}^3$, $E = 200 \text{ GPa}$.	20	L2	CO5
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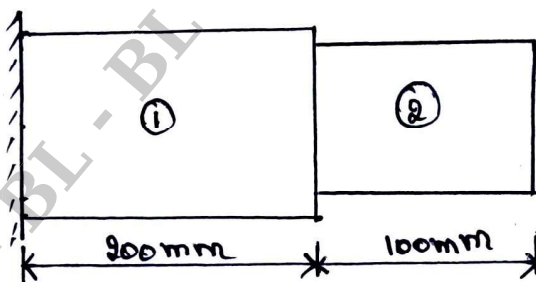


Fig.Q.9

OR

Q.10

A composite wall consist of three materials as shown in Fig.Q.10. The outer temperature is $T_0 = 20^\circ\text{C}$, convective heat transfer takes place on the inner surface of the wall with $T_\infty = 800^\circ\text{C}$ and $h = 25 \text{ W/m}^2\text{C}$. Determine the temperature distribution in the wall.

20

L3

CO3

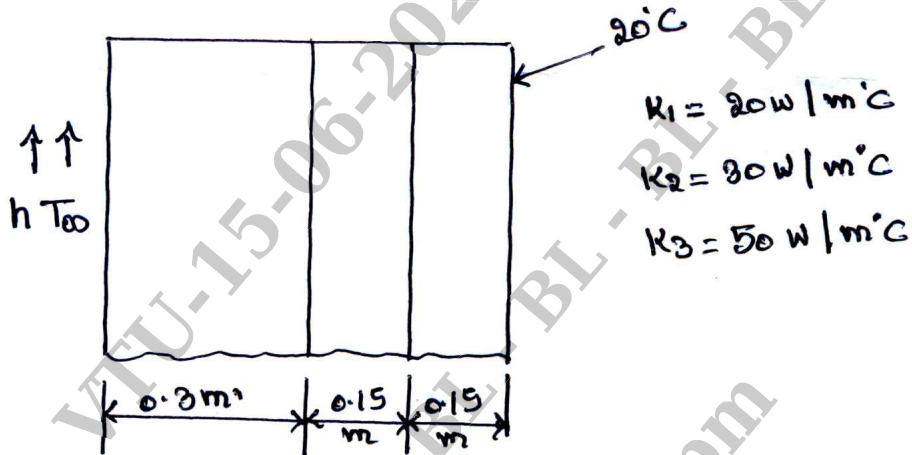


Fig.Q.10

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Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026

Hydraulics and Pneumatics

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Sketch and explain the components used in hydraulic control system.	10	L1	CO1
	b.	What are the desirable properties of a hydraulic fluid explain any three?	10	L1	CO1
OR					
Q.2	a.	State Pascal's law. Explain briefly its application.	10	L1	CO1
	b.	Sketch and explain different filtering system in a hydraulic circuit.	10	L2	CO1
Module – 2					
Q.3	a.	With the help of diagram, explain the construction and working of external gear pump.	10	L2	CO2
	b.	A pump having a displacement volume of 90 cm ³ delivers 82 LPM at 1000 rpm and 6.9 MPa. If the input torque is 102 Nm, find (i) The overall efficiency of pump. (ii) Theoretical torque required to operate pump.	10	L3	CO2
OR					
Q.4	a.	With the aid of neat sketch, explain the principal of operation of internal gear pump.	10	L2	CO2
	b.	Explain the following single acting cylinder with neat sketches : (i) Telescopic (ii) Tandem	10	L2	CO2
Module – 3					
Q.5	a.	Explain compensated and non compensated flow control valve. Also draw the symbol.	10	L2	CO3
	b.	Explain the working of pilot operated check valve with a neat sketch. Illustrate graphical symbol of the valve.	10	L3	CO3
OR					
Q.6	a.	Explain with a neat sketch of pilot operated pressure relief valve.	10	L2	CO3
	b.	Explain the following valves with a neat sketch : (i) Sequence valve (ii) Counter balance valve	10	L3	CO3

Module – 4					
Q.7	a.	With a neat sketch, explain the structure of pneumatic system.	10	L2	CO4
	b.	State the advantages and disadvantages of pneumatic systems.	10	L1	CO4
OR					
Q.8	a.	Explain different types of seal with a neat sketch.	10	L2	CO4
	b.	Sketch and explain the mechanism of end position cushioning.	10	L2	CO4
Module – 5					
Q.9	a.	Explain a typical pneumatic circuit with OR logic using shuttle valve.	10	L2	CO5
	b.	Explain the principle of cascade control system.	10	L2	CO5
OR					
Q.10	a.	What are the different methods of signal elimination? Explain.	10	L1	CO5
	b.	Explain displacement step and displacement time diagrams.	10	L2	CO5

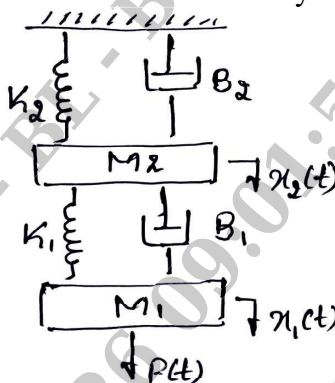
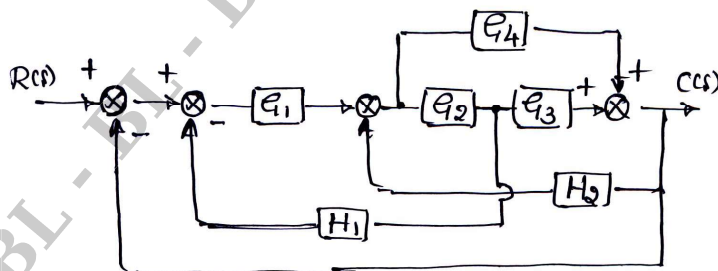
Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026

Control Engineering

Time: 3 hrs.

Max. Marks: 100

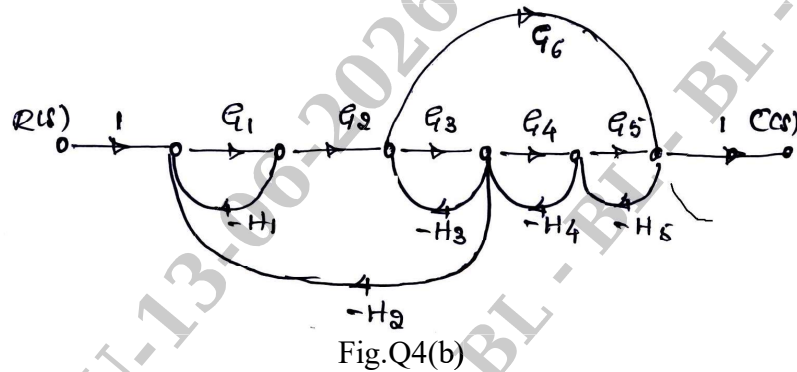
*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Explain open loop and closed loop control system, with two examples for each.	10	L2	CO1
	b.	What are the requirements of a control system? Briefly explain.	5	L1	CO1
	c.	Draw the block diagram of proportional plus integral controller and explain.	5	L2	CO1
OR					
Q.2	a.	Determine the transfer function of mechanical system show in Fig.Q2(a).	15	L3	CO1
		 Fig.Q2(a)			
	b.	Explain with block diagram on proportional plus derivative controller.	5	L2	CO1
Module – 2					
Q.3	a.	Explain with block diagram, series and feedback compensation.	6	L2	CO3
	b.	Reduce the block diagram shown in Fig.Q3(a) to its simplest possible form and find its closed loop transfer function.	14	L3	CO3
		 Fig.Q3(b)			

1 of 3

OR

Q.4	a.	Explain : i) Lead compensator ii) Lag compensator.	6	L2	CO3
	b.	Find the transfer function by using Mason's gain formula for the signal flow graph shown in the Fig.Q4(b).	14	L3	CO3



Module – 3

Q.5	a.	Define : i) Delay time ii) Rise time iii) Peak time iv) Maximum overshoot.	8	L1	CO2
	b.	Derive an expression for time response of first order system subjected to i) Step input ii) Ramp input.	12	L3	CO2

OR

Q.6	a.	Obtain an expression for time response of the second order mechanical system subjected to unit step input for under damped case. Also show the response curve.	12	L2	CO2
	b.	A unity feedback system is characterised by open loop transfer function : $G(s) = \frac{10}{s^2 + 2s + 6}$ Determine the following when the system subjected to unit step input i) Damping ratio ii) Undamped natural frequency iii) Peak overshoot iv) Peak time.	8	L4	CO2

Module – 4

Q.7	a.	Analyze the stability of the system given by characteristics equation : $S^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$ By Routh-Hurwitz criterion.	8	L5	CO4
	b.	Sketch the root locus plot for the system with OLTF. $G(s)H(s) = \frac{K(s+3)}{s(s+1)(s+2)}.$	12	L4	CO4

OR

Q.8		Sketch the root locus plot for the system with OLTF $G(s)H(s) = \frac{K}{s(s+2)(s+4)(s+6)}$ Also find the range of 'K' for which the system is stable.	20	L5	CO4
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Module – 5

Q.9	a.	Explain Nyquist stability criteria and list the advantages of Nyquist plot	6	L2	CO4
	b.	Comment on stability of the system using Nyquist stability criterion whose open loop transfer function is given by : $G(s)H(s) = \frac{K}{s(s+2)(s+10)}.$	14	L3	CO4

OR

Q.10		Sketch the Bode plot for the system with $G(s)H(s) = \frac{2}{s(s+1)(1+0.2s)}$ Also obtain gain margin and phase margin and crossover frequencies.	20	L5	CO4
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CBCS SCHEME

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BME714C

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026

IC Engines

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1				M	L	C
Q.1	a.	Classify the Multicylinder engines based on various factors.	10	L2	CO1	
	b.	Brief the following terms : i) Adiabatic flame temperature ii) Real Vs Ideal cycles iii) Variable specific heats iv) Air Fuel ratio v) Combustion charts	10	L2	CO2	
OR						
Q.2	a.	Mention the materials used and manufacturing process adopted for the following components of IC engines. i) Cylinder Block ii) Cylinder Head iii) Piston iv) Connecting rod v) Valves.	10	L2	CO1	
	b.	Write the minimum of 5 selection criteria of IC engines based on their application.	10	L2	CO2	
Module – 2						
Q.3	a.	With a neatly labelled diagram explain the working principle of simple carburetor.	10	L2	CO3	
	b.	Define Knocking. List and explain factors which affect knocking [minimum five].	10	L3	CO3	
OR						
Q.4	a.	With a neat P-θ [Pressure – Crank Angle] diagram, explain combustion process in CI engine.	10	L2	CO3	
	b.	Define Detonation in CI Engine. List and explain four factors which affect detonation.	10	L3	CO3	
Module – 3						
Q.5	a.	What are the needs for different types of combustion chambers for SI engines and explain 'F' head combustion chamber.	10	L3	CO3	
	b.	Explain Alcohols as alternate fuels for SI engines.	10	L2	CO4	

OR					
Q.6	a.	With a neatly labelled diagram, explain 'M' type of combustion chamber.	10	L3	CO4
	b.	Explain Biogas as Diesel Engine Fuel.	10	L2	CO4
Module – 4					
Q.7	a.	With a neatly labelled diagram, explain Jerk Pump Injectors.	10	L3	CO4
	b.	Define Nozzle and explain three different types of nozzles.	10	L3	CO4
OR					
Q.8	a.	With a neat diagram, explain Electronic Fuel Injection System.	10	L3	CO4
	b.	What are Cooling Units? With a neat sketch explain water cooled engines.	10	L3	CO4
Module – 5					
Q.9	a.	Brief about the following : i) Rotary Piston Engine ii) Stratified Charge Engine	10	L3	CO5
	b.	With proper reaction and diagram, explain catalytic converter.	10	L3	CO5
OR					
Q.10	a.	Brief the following : i) Turbo Charged Engine ii) Super Charged Engine	10	L3	CO5
	b.	With a neatly labelled diagram, explain Exhaust Gas Recirculation (EGR) system.	10	L3	CO5

CBCS SCHEME

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BME755D

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026 Non Conventional Energy Resources

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1			M	L	C
Q.1	a.	Enlist the merits and demerits of any three non-conventional energy sources.	10	L1	CO1
	b.	Explain Tar sands and oil shale as energy sources and also mention its limitations.	10	L1	CO1
OR					
Q.2	a.	With a neat sketch, explain the working of pyranometer.	5	L2	CO1
	b.	Write short note on solar constant and solar radiation at the earth's surface.	5	L1	CO1
	c.	Discuss with the help of recent statistics commercial and non-commercial energy reserves and production in India.	10	L2	CO1
Module – 2					
Q.3	a.	Define the following with proper diagram. i) Declination angle ii) Hour angle iii) Latitude angle iv) Zenith angle v) Surface azimuth angle.	10	L1	CO2
	b.	List the different types of concentrating collectors. Explain any one of them with a neat sketch.	10	L1	CO2
OR					
Q.4	a.	With a neat sketch, explain the working principle of solar pond.	12	L2	CO2
	b.	Determine the local solar time and declination at a location latitude 23°15'N, longitude 77°30'E at 12.30 IST on June 19. Equation of time correction is = - (1' 01")	8	L3	CO2
Module – 3					
Q.5	a.	Explain working principle characteristics, and application of photovoltaic conversion.	10	L2	CO3
	b.	Explain any four parameters that affect the performance of the collector.	10	L2	CO3

OR					
Q.6	a.	Write short note on collector efficiency factor and collector heat removal factor.	10	L1	CO3
	b.	Plot the variation of transmissivity of cover system (τ), transmissivity obtained by considering only reflection (τ_r), only absorption (τ_a) with the angle of incidence for the following cover system. Material : Glass, No. of covers = 2 Thickness of each cover = 4 mm Refractive index of glass relative to air = 1.52 Extinction coefficient of glass = 15m^{-1} , ($\theta_1 = 15^\circ$)	10	L3	CO3
Module – 4					
Q.7	a.	With a neat sketch, explain the horizontal axis wind machine.	8	L2	CO4
	b.	Sketch and explain single basin type tidal power plant operation.	8	L2	CO4
	c.	What are the problems associated with ocean thermal energy conversion?	4	L4	CO4
OR					
Q.8	a.	With a neat sketch, explain the working principle of a OTEC (closed) plant.	8	L2	CO4
	b.	A 10m/s wind is at 1 standard atmospheric pressure at 15°C temperature. Calculate : i) Total power density in wind stream ii) A reasonable obtainable power density in W/m^2 iii) Maximum obtainable power density iv) Total power in (kW) if turbine diameter is 120 m. Assume conversion efficiency 40% ($1\text{ atm} \rightarrow p \approx 1.225\text{ Kg/m}^3$).	8	L3	CO4
	c.	List the limitations of Tidal plants.	4	L1	CO4
Module – 5					
Q.9	a.	Discuss briefly the methods of hydrogen storage.	5	L2	CO5
	b.	Describe constructions and working principle of geothermal energy with schematic diagram.	10	L1	CO5
	c.	Explain the benefits and applications of biogas.	5	L2	CO5
OR					
Q.10	a.	Explain the biomass sources available for biogas generation.	4	L2	CO5
	b.	List the various sources of geothermal energy. What are the problems associated with geothermal energy conversion?	8	L1	CO5
	c.	Explain the process of electrolytic production of hydrogen, with a neat sketch.	8	L2	CO5