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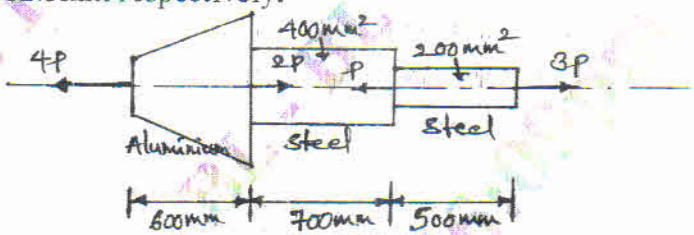
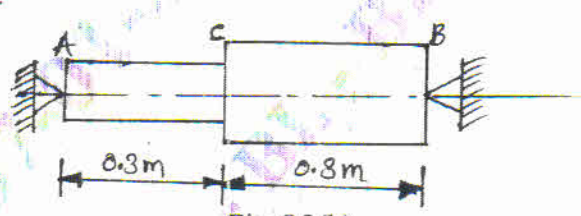
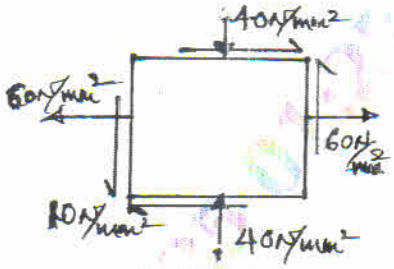
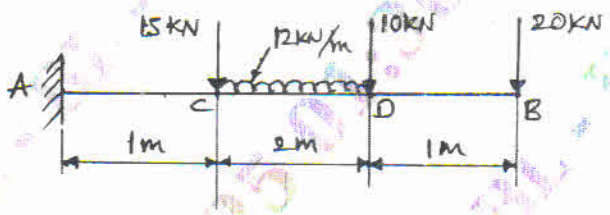
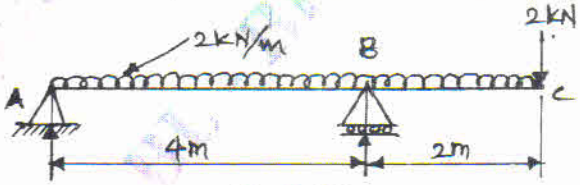
BME301

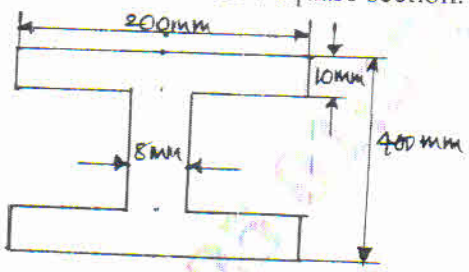
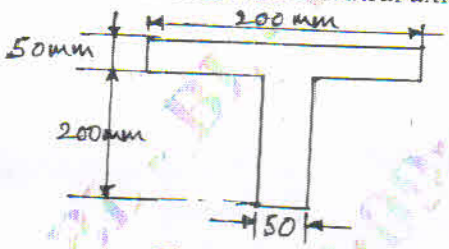
Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mechanics of Materials

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 the following terms: (i) Poisson's ratio (ii) Factor of safety	04	L1	CO1
	b.	Show that the expression for the extension of uniformly tapering circular bar subjected to an axial load 'P' is given by, $\delta = 4PL/\pi d_1 d_2 E$	06	L1	CO1
	c.	A bar with stepped portion is subjected to the forces shown in Fig.Q1(c). Solve for the magnitude of force 'P' such that net deformation in the bar does not exceed 1 mm. E for steel is 200 GPa and that of aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively.  Fig.Q1(c)	10	L3	CO1
		OR			
Q.2	a.	How do you relate Modulus of Elasticity and Bulk modulus?	10	L1	CO1
	b.	Solve for the values of stress and strain in portion AC and CB of the steel bar shown in Fig.Q2(b). A close fit exists at both the rigid supports at room temperature and the temperature is raised by 75°C. Take E = 200 GPa and $\alpha = 12\times10^{-6}$/°C for steel. Area of cross-section of AC is 400 mm² and of BC is 800 mm².  Fig.Q2(b)	10	L3	CO1
		Module – 2			
Q.3	a.	A rectangular bar is subjected to two direct stresses 'σ_x' and 'σ_y' in two mutually perpendicular directions. Show that the normal stress 'σ_n' and shear stress 'τ' on an oblique plane which is inclined at an angle 'θ' with the axis of minor stress are given by $\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta$ and $\tau = -\left(\frac{\sigma_x - \sigma_y}{2}\right)\sin 2\theta$	10	L1	CO2

	b.	The state of stress at a point in a stained material is shown in Fig.Q3(b). Identify (i) Direction of principal planes (ii) Magnitude of principal stresses (iii) Magnitude of maximum shear-stress and its direction.  Fig.Q3(b)	10	L3	CO2
		OR			
Q.4	a.	Show that the change in volume of thin cylindrical shell is given by $\delta_V = \frac{Pd}{4tE}(5-4M)\nu$	10	L1	CO2
	b.	A pipe of 500 mm internal diameter and 75 mm thick is filled with a fluid at a pressure of 6 N/mm^2. Solve for the maximum and minimum hoop stress across the cross-section of the cylinder. Also construct the radial pressure and hoop stress distribution sketch across the section.	10	L3	CO2
		Module – 3			
Q.5	a.	Explain with sketches, the different types of loads acting on a beam.	10	L2	CO3
	b.	A cantilever beam carries UdL and point loads as shown in Fig.Q5(b). Construct SFD and BMD.  Fig.Q5(b)	10	L3	CO3
		OR			
Q.6	a.	Explain SFD and BMD for a cantilever beam with a uniformly varying load.	10	L2	CO3
	b.	An overhanging beam ABC is located as shown in Fig.Q6(b). Develop the SFD and BMD. Also locate point of contraflexure.  Fig.Q6(b)	10	L3	CO3
		Module – 4			
Q.7	a.	Explain the assumptions made in simple bending and show that the maximum transverse shear stress is 1.5 times the average shear stress in a beam of a rectangular section.	10	L2	CO4

	b.	The cross-section of a beam is as shown in Fig.Q7(b). If permissible stress is 150 N/mm^2. Find its moment of resistance and compare it with equivalent section of the same area for a square section.  Fig.Q7(b)	10	L4	CO4
		OR			
Q.8	a.	Illustrate an expression for the bending stress and radius of curvature for a straight beam subjected to pure bending.	10	L2	CO4
	b.	A 'T' shaped cross-section of a beam shown in Fig.Q8(b) is subjected to a vertical shear force of 100 KN. Inspect the shear stress at the neutral axis junction and flange. MI about the horizontal neutral axis is 0.0001134 m^4.  Fig.Q8(b)	10	L4	CO4
		Module – 5			
Q.9	a.	Explain the assumptions made in pure torsion-theory and show that $\frac{T}{J_p} = \frac{\tau}{R} = \frac{G\theta}{L}$	10	L2	CO5
	b.	A hallow shaft having internal diameter 40% of its external diameter, transmits 562.5 KW power at 100 rpm. List the internal and external diameters of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 2.5m should not exceed 1.3 degrees. The maximum torque being 25% greater than mean. G = 9×10^4 N/mm^2.	10	L4	CO5
		OR			
Q.10	a.	Show the variation of Euler's critical load with slenderness ratio. Explain the limitations of Euler's theory and mention for formulae to overcome these limitations.	10	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, analyze the safe load using (i) Rankine's formula taking yield stress 560 N/mm^2 and α = 1/1600. (ii) Euler's formula, taking E = 1.2×10^5 N/mm^2.	10	L4	CO5

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BME302

Third Semester B.E./B.Tech. Degree Examination, June/July 2025

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.	What is Pattern? Explain the following patterns used in sand casting. i) Split pattern ii) Match plate pattern iii) Sweep pattern	10	L2	CO1
	b.	Sketch and Explain Jolt type moulding machine.	10	L2	CO1
		OR			
Q.2	a.	Illustrate the different steps involved in shell moulding process.	10	L2	CO1
	b.	Explain how to determine the amount of clay present in the foundry sand.	10	L2	CO1
		Module – 2			
Q.3	a.	Explain with neat sketch the construction and working of direct arc electric furnace.	10	L2	CO2
	b.	With a neat sketch, explain resistance furnace.	10	L2	CO2
		OR			
Q.4	a.	What is die casting? With a neat sketch explain hot chamber die casting process.	10	L2	CO2
	b.	With a neat sketch explain semi-centrifugal casting process.	10	L2	CO2
		Module – 3			
Q.5	a.	Distinguish between hot working and cold working process.	10	L4	CO3
	b.	Derive an expression for wire drawing load by slab analysis.	10	L3	CO1
		OR			
Q.6	a.	Explain bending operations with suitable sketches.	10	L2	CO3
	b.	With neat sketches, explain combination die and progressive die.	10	L2	CO3
		Module – 4			
Q.7	a.	With a neat sketch, Explain Gas Tungsten Arc Welding (GTAW) Process.	10	L2	CO4
	b.	Distinguish between GAS Metal Arc Welding (GMAW) and Gas Tungsten Arc Welding (GTAW).	10	L1	CO4
		OR			
Q.8	a.	Explain submerged Arc Welding (SAW) process with a neat sketch.	10	L2	CO4
	b.	Analyze the types of flames that can be obtained during oxy-acetalene welding process.	10	L2	CO4
		Module – 5			
Q.9	a.	Explain the following weld defects with neat sketches. i) Inclusion ii) Over penetration iii) Porosity iv) Undercut v) Spatter	10	L2	CO5
	b.	Write a note on Heat Affected Zone (HAZ) in welding with neat sketch.	10	L1	CO5
		OR			
Q.10	a.	Define soldering. Explain soldering iron process with a neat sketch.	10	L2	CO5
	b.	With a neat sketch. Explain friction stir welding process.	10	L2	CO1

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BME303

Third Semester B.E./B.Tech. Degree Examination, June/July 2025

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
Q.1	a.	Explain classification of materials. Compare crystalline solids and non crystalline solids.	10	L2	CO1
	b.	Define (i) Crystal lattice (ii) Unit cell (iii) Planar atomic density (iv) Coordination number (v) Atomic packing factor.	10	L1	CO1
		OR			
Q.2	a.	Derive atomic packing factor for simple cubic structure.	10	L2	CO1
	b.	Explain edge and screw dislocations.	10	L2	CO1
		Module – 2			
Q.3	a.	State and explain HumeRothery rules.	10	L1	CO2
	b.	Explain Fick's laws of diffusion.	10	L2	CO2
		OR			
Q.4	a.	Explain iron-carbon diagram with a sketch.	10	L2	CO2
	b.	Two metals A and B are used to form an alloy containing 75% A and 25% B. A melts at 650°c and B at 450°c. The solid solubility of metal A is B and of B is A are negligible. The metal pair forms an eutectic at 40% A and 60% B which solidifies at 300°c. Assume liquids and solidus lines are straight draw phase diagram for the alloy series.	10	L3	CO2
		Module – 3			
Q.5	a.	Explain (i) Annealing (ii) Normalizing (iii) Hardening (iv) Tempering (v) Nitriding.	10	L1	CO3
	b.	Explain with sketch Joming End Quench test.	10	L2	CO3
		OR			
Q.6	a.	Explain with a neat sketch flame hardening.	10	L2	CO3
	b.	Explain with a graph T-T-T diagram.	10	L2	CO3
		Module – 4			
Q.7	a.	With a neat sketch explain physical vapours deposition.	10	L2	CO4
	b.	Write advantages and disadvantages of surface coating.	10	L2	CO4
		OR			
Q.8	a.	Explain different powder production techniques in mechanical methods.	10	L2	CO4
	b.	Explain the functions of lubricants and binders in powder metallurgy.	10	L2	CO4
		Module – 5			
Q.9	a.	State properties, composition and uses of low, medium and high carbon steels.	10	L2	CO5
	b.	Explain with sketch hand-layup process.	10	L2	CO5
		OR			
Q.10	a.	Briefly explain the selection criteria for selection of materials.	10	L2	CO5
	b.	With a sketch explain filament winding process.	10	L2	CO5

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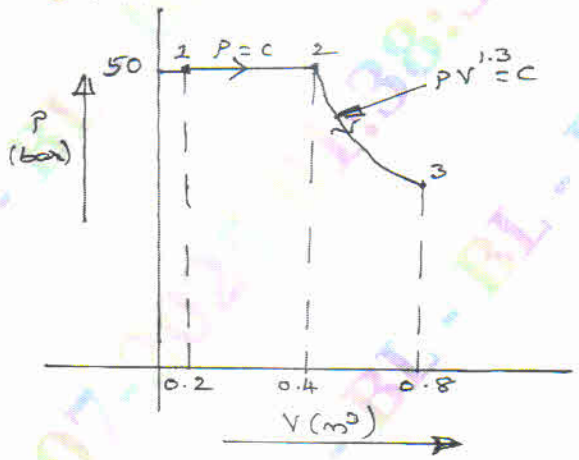
BME304

Third Semester B.E./B.Tech. Degree Examination, June/July 2025
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 thermodynamics data hand book and steam tables is permitted.

		Module – 1	M	L	C
Q.1	a.	State Zeroth Law of thermodynamics. Explain its significance in the measurement of temperature.	6	L2	CO1
	b.	Prove that work is a path function.	4	L2	CO1
	c.	The temperature 't' on a thermometric scale is defined in terms of property P by the relation $t = a \ln p + b$, where a and b are constants. Experiments give values of P as 1.86 and 6.81 at the ice point and the steam point respectively. Evaluate the temperature 't' on the Celsius scale corresponding to a reading of P = 2.5 on the thermometer.	10	L3	CO1
		OR			
Q.2	a.	Define work from mechanics point of view and thermodynamics point of view. Explain the sign convention of work.	6	L2	CO1
	b.	Derive an expression for P-dV work for a polytropic process.	6	L3	CO1
	c.	Determine the total work done in a gas system following the expression process shown in Fig.Q2(c).  Fig.Q2(c)	8	L3	CO1
		Module – 2			
Q.3	a.	State and explain the first law of thermodynamics for closed system undergoing a cycle process.	4	L2	CO2
	b.	Prove that internal energy is a property of the system.	6	L3	CO2
	c.	The work and Heat are taken with several processes as a result of which the final state is identical with the initial state. The work transfer and the heat transfer are given in the Table Q3(c). Complete the cycle.	10	L3	CO2

Process	Q(kJ)	W(kJ)	du(kJ)
1 – 2	200	500	- - - - -
2 – 3	- - - - -	300	400
3 – 4	- - - - -	–200	- - - - -
4 – 1	50	0	- - - - -

Table Q3(c)

		OR			
Q.4	**a.**	Write a note on Perpetual Motion Machine of Kind I (PMMK I)	**4**	**L2**	**CO2**
	b.	With a neat sketch of steady flow device, write the steady flow energy equation with usual notations.	**6**	**L2**	**CO2**
	c.	The working fluid in a steady flow process flows at the rate of 220kg/min. The fluid rejects 100 kJ/s of heat passing through the system. The fluid enters at a velocity of 320 m/s, pressure 6 bar, internal energy 2000 kJ/kg, specific volume 0.36 m^3/kg and leaves the system at a velocity of 140 m/s, pressure 1.2 bar, internal energy 1400 kJ/kg, specific volume 1.3 m^3/kg. Determine the power output in KW. The change in potential energy is neglected.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Explain the limitations of first law of thermodynamics.	**4**	**L2**	**CO3**
	b.	Give the Kelvin-Plands statement and Clausicus statement of second law of thermodynamics.	**4**	**L2**	**CO3**
	c.	Define a heat engine, a heat pump and a refrigerator. Write the mathematical expressions for the efficiency of a heat engine, COP of a heat pump and a refrigerator. Prove that $(COP)_{Heat\ pump} = 1 + (COP)_{Refrigerator}$.	**12**	**L2**	**CO3**
		OR			
Q.6	**a.**	State and prove Clausius inequality.	**6**	**L3**	**CO3**
	b.	Explain the principle of increase of entropy.	**6**	**L2**	**CO3**
	c.	A heat engine receives 300 kJ/min of heat from a source at 327°C and rejects heat to a sink at 27°C. The hypothetical amounts of heat rejection are : i) 200 kJ/min ii) 150 kJ/min iii) 100 kJ/min. From these results, state which of these cores is a reversible cycle, irreversible cycle and impossible one.	**8**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	With a neat sketch, explain how the dryness fraction of steam is determined using a combined separating and throttling calorimeter.	**10**	**L2**	**CO4**
	b.	Superheated steam from an initial condition of 5 bar and 300°C is expended isentropically to a pressure of 0.5 bars. Calculate : i) Find condition of steam after expansion ii) Change in enthalpy/kg of steam iii) Change in internal energy /kg of steam.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Explain the following terms : i) Triple point ii) Critical point iii) Sub cooled liquid iv) Quality of steam v) P – V – T surfaces.	**10**	**L2**	**CO4**
	b.	Derive an expression for the available energy from C_1 finite energy source at temperature T_1 when the surrounding temperature is T_0.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the following : i) Maxwell's relations ii) Clausius Clapeyron equation.	**8**	**L2**	**CO5**
	b.	State and explain Dalton's law of partial pressure and Anagat's law of additive volumes.	**6**	**L2**	**CO5**
	c.	Define the following terms : i) Mass fraction ii) Mole fraction iii) Volume fraction.	**6**	**L2**	**CO5**
		OR			
Q.10	**a.**	Write a note on compressibility factor and generalized compressibility chart.	**10**	**L2**	**CO5**
	b.	Determine the pressure exerted by CO_2 in a container of 1.5 m^3 capacity when it contains 5 kg at 27°C using : i) Ideal gas equation ii) Vander Waal's equation . Find the compressibility factor using the value of pressure obtained from Vanderwaal's equation.	**10**	**L3**	**CO5**

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BME306A

Third Semester B.E./B.Tech. Degree Examination, June/July 2025
Electric and Hybrid Vehicle Technology

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.	Discuss the history of hybrid electric vehicles. Dissect the environmental importance of EV and their social impacts.	10	L2	CO1
	b.	Enlist the different architectures of hybrid electric drive train and explain the series hybrid electric drive train.	10	L2	CO1
		OR			
Q.2	a.	State and explain the dynamic equations of vehicle motion.	10	L2	CO1
	b.	Under what condition a pure EV can be choosen as a better option compared to hybrid vehicles considering the impact on climate change.	10	L2	CO1
		Module – 2			
Q.3	a.	Elaborate energy management system and issues of energy management strategies of EHV.	10	L2	CO2
	b.	Classify and explain the different energy management strategies.	10	L2	CO2
		OR			
Q.4	a.	Explain fuel cell and fly wheel as energy source elements in electric and hybrid electric vehicles.	10	L2	CO2
	b.	Explain battery management system in electric and hybrid vehicles.	10	L2	CO2
		Module – 3			
Q.5	a.	Discuss the types of electrical motors used in electric and hybrid vehicles.	10	L2	CO3
	b.	Explain the types of induction motor drives and their control characteristics.	10	L2	CO3
		OR			
Q.6	a.	Discuss Brushes and Brushless DC motors and their characteristics.	10	L2	CO3
	b.	Explain about IPM motor drives and their characteristics.	10	L2	CO3
		Module – 4			
Q.7	a.	Explain design parameters of batteries, ultra capacitors used in hybrid electrical vehicles.	10	L2	CO4
	b.	Summarize the aero-dynamic shape considerations while designing the EV and HEV.	10	L2	CO4
		OR			
Q.8	a.	Explain the working principle of fuel cell and its analysis.	10	L2	CO4
	b.	Explain the rolling resistance and aero-dynamic drag in vehicles.	10	L2	CO4
		Module – 5			
Q.9	a.	Explain the battery smart charging system in electric vehicle technology.	10	L2	CO5
	b.	Discuss the battery charging stations and its installation and commissioning.	10	L2	CO5
		OR			
Q.10	a.	Discuss the estimation on station capacity and associated technical issues in electric battery charging system.	10	L2	CO5
	b.	Describe the different types of connectors used for charging electrical batteries.	10	L2	CO5

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BME401

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
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 of Thermodynamic data handbook is permitted.

		Module – 1	M	L	C
Q.1	a.	With P-V and T-S diagrams, derive air standard efficiency of diesel cycle. State the assumptions made.	10	L3	CO1
	b.	The compression ratio of an air standard Otto cycle is 8. At the beginning of compression process, the pressure is 1 bar and the temperature is 300K. The heat transfer to the cycle is 1900 kJ/kg of air. Calculate i) pressure and temperature at the end of each process of the cycle ii) Thermal efficiency iii) Mean effective pressure.	10	L3	CO1
		OR			
Q.2	a.	With a p – θ diagram, explain the stages of combustion in SI engine.	10	L2	CO1
	b.	In a test on three cylinder four stroke IC engine, with 22 cm bore and 26 cm stroke, the following observations were made during a trail period of 1 hour. Fuel consumption = 8 kg ; Air comsumption = 300 kg ; Ambient temperature = 30° C ; Calorific value of fuel = 45000 kJ/kg ; Net load on the brake = 1500 N ; Brake drum diameter = 1.8 m ; Rope diameter = 3 cm ; Mass of cooling water circulated = 550 kg ; Inlet and exit temperature of cooling water = 27 °C and 55 °C. Total revolutions of the cycle = 12000 m.e.p = 6 bar. Exhaust gas temperature = 310 °C ; C_p for exhaust gases = 1.1 kJ/kg K. Calculate IP , BP , Mechanical efficiency and indicated thermal efficiency. Draw up heat balance sheet on minute basic.	10	L3	CO1
		Module – 2			
Q.3	a.	With a block diagram and T – S diagram, explain , how intercooling , reheating and regenerating improves thermal efficiency of gas turbine plant.	10	L2	CO2
	b.	In a regenerative gas turbine cycle, air enters the compressor at 1 bar, 15°C. The pressure ratio is 6. The isentropic efficiency of compressor and turbine is 0.8 and 0.85 respectively. The maximum temperature in the cycle is 800 °C. The effectiveness of regenerator is 0.78. Assume C_p = 1.005 kJ/kg K, γ = 1.4 for air and C_p = 1.4 kJ/kg K , γ = 1.32 for combustion products. Find the cycle efficiency.	10	L3	CO2
		OR			
Q.4	a.	With a neat diagram, explain the working of Turbo prop. Also draw T – S diagram.	10	L2	CO2
	b.	With a neat sketch, explain the working of Rocket engine.	10	L2	CO2

		Module – 3			
Q.5	**a.**	With a neat sketch, explain the working of Reheat Rankine cycle. Show the processes on P – V and T – S diagrams.	**10**	**L2**	**CO3**
	b.	A simple Rankine cycle works between the pressures of 30 bar and 0.04 bar. The initial condition of steam being dry saturated. Calculate the cycle efficiency , work ratio and specific steam consumption.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	With a T – S diagram, explain the effect of following parameters on Ranking cycle efficiency. i) Pressure of steam at inlet to turbine. ii) Pressure of steam at the end of expansion.	**10**	**L2**	**CO3**
	b.	A regenerative cycle operated with steam supplied at 30 bar and 300 °C and condenser pressure of 0.08 bar. The extraction points for two open type feed water heaters are at 3.5 bar and 0.7 bar. Calculate thermal efficiency of the plant neglecting pump work.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	With a schematic diagram, explain the working of vapour absorption refrigeration system. Show the processes on T – S diagram.	**10**	**L2**	**CO4**
	b.	An ammonia vapour compression refrigeration system operates between evaporator pressure of 1.9 bar and condenser pressure of 15.6 bar. The vapour has a dryness fraction of 0.864 at entry to the compressor. Determine COP and refrigeration effect produced for a work input of 1 kW.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	With a neat schematic diagram, explain the working of summer air conditioning for hot and dry weather. Show the processes on psychrometric chart.	**10**	**L2**	**CO4**
	b.	Following data refers to an air conditioning system to be designed for an industrial process for hot and wet climate. Outside conditions : 30°C DBT , 75% RH Required inside conditions : 20°C DBT , 60% RH. The required condition is achieved first by cooling and dehumidifying and then by heating. Find i) Capacity of cooling coil in TOR ii) Capacity of heating coil in kW iii) Amount of water vapour removed per hour.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	For a single acting reciprocating air compressor, show that the clearance volume do not effect the work of compression.	**10**	**L4**	**CO5**

	b.	Air at 1 bar and 27°C is compressed to 7 bar by a single stage reciprocating compressor according to the law $PV^{1.3} = C$. The free air delivered was 1 m^3/min. Speed of compressor = 300 rpm , Stroke to bore ratio = 1.5 , Mechanical efficiency = 85% and motor transmission efficiency = 90%. Determine i) IP and Isothermal efficiency ii) Cylinder dimensions iii) Power of the motor.	10	L3	CO5
		OR			
Q.10	a.	Derive Critical pressure ratio expression for a flow through steam nozzle.	10	L4	CO5
	b.	Dry saturated steam at a pressure of 11 bar enters a C – D nozzle and leaves at a pressure of 2 bar. If the flow is adiabatic frictionless, determine i) exit velocity of steam ii) Ratio of cross – sectional area at exit to throat. Assume condition for maximum discharge.	10	L3	CO5

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BME402

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
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.	Distinguish between orthogonal cutting and oblique cutting with neat sketches. Also justify which type of cutting method is preferred, why?	06	L2	CO1
	b.	With a neat sketch, explain single point cutting tool nomenclature.	06	L2	CO1
	c.	The following data are obtained during a turning operation on a Lathe, cutting Force = 120 kg, Feed force = 30 kg, Rake angle = 15°, Feed rate = 0.2 mm/rev, chip thickness = 0.3 mm, cutting speed = 100 m/min, work piece diameter = 120 mm, Depth of cut = 0.4 mm. calculate, a) Chip thickness ratio b) Shear angle c) Co-efficient of friction d) Friction angle e) Shear stress	08	L3	CO1
		OR			
Q.2	a.	Mention the assumption of merchant circle model, draw the neat sketch of merchant circle with all the notation.	06	L2	CO1
	b.	Derive the relation between Rake angle, shear angle and Frictional angle.	08	L2	CO1
	c.	With a neat sketch explain the principle of Lathe machine. Also distinguish between Turret Lathe and Capstan Lathe.	06	L2	CO1
		Module – 2			
Q.3	a.	Explain the constructional feature of column and knee type milling machine with a neat sketch.	06	L2	CO2
	b.	What is Indexing? Mention the different method, also write the steps for Indexing 69 divisions.	08	L3	CO2
	c.	Distinguish between Up milling and Down milling with sketches.	06	L2	CO2
		OR			
Q.4	a.	Explain the constructional feature of radial drilling machine with a neat sketch.	06	L2	CO2
	b.	A 12 mm hole is to be drilled through a 20 mm thick plate. The cutting speed is 12 m/min and the feed rate is 0.12 mm/rev. Estimate the machining time. Take the over travel plus the clearance of the tool as 5 mm.	08	L3	CO2
	c.	Distinguish between shaping and planning machine.	06	L2	CO2
		Module – 3			
Q.5	a.	With a neat sketch Explain the different temperature zones during metal cutting process.	06	L2	CO3
	b.	Determine the percentage change in the cutting speed required to give 60% reduction in tool life. The speed /life of the tool relationship is given by $VT^n = G$. Take $n = 0.2$.	08	L3	CO3
	c.	What are the functions of coolants in metal cutting process. Mention some of the coolants used during metal cutting.	06	L2	CO3

		OR			
Q.6	**a.**	What do you mean by tool life? Mention the tool life equation with usual notation, also mention the parameters on which tool life is depending.	**06**	**L2**	**CO1**
	b.	Explain with a neat sketch, Flank and creator wear.	**06**	**L2**	**CO3**
	c.	A lathe turning at a particular speed is cutting a mild steel work piece with H.S.S tool. The speed – life relationship for the tool is given by $VT^{0.4} = 400$. Determine the percentage increase in the tool life of the cutting speed is reduced by 20%	**08**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	What are the difference between line standards and end standards. Also mention the characteristics of Line standards.	**08**	**L2**	**CO1**
	b.	Explain the wringing phenomenon with a neat sketch.	**06**	**L2**	**CO1**
	c.	List the slips to be wrung together to produce on overall dimension of 92.357 mm using two protection slips of 2.500 mm size. Show the slip gauge combination.	**06**	**L3**	**CO4**
		OR			
Q.8	**a.**	Define Fit. Explain the types of fit and their designation. With sketches. (any 2)	**06**	**L2**	**CO4**
	b.	With a neat sketch, Explain Hole basis system and shaft basis system.	**06**	**L2**	**CO4**
	c.	Determine the dimension of the shaft and hole for a fit 30 H_8/d_{10} and sketch the fit for the following. i) Diameter 30 falls in the dia range 18-30, upper deviation for "d" shaft is $-16\ D^{0.44}$ ii) $i=0.45\ D^{1/3} + 0.001\ D$. Tolerance for IT 8 = 25i, Tolerance for IT10 = 64i	**08**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the following with neat sketches. i) Plug gauges ii) Ring gauges iii) Snap gauge iv) Concept of limits of size and Tolerance	**12**	**L2**	**CO5**
	b.	Determine the type of fit after deciding the fundamental deviation and tolerance in the following. Also sketch the fit : i) Fit $\phi 70\ H_9\ e_7$ Diameter step (50-80) ii) Fundamental deviation for e shaft $= -11D^{0.41}$ Take, IT7 = 16i and IT9 = 40i, $i = 0.45\sqrt[3]{D} + 0.001D$	**08**	**L3**	**CO5**
		OR			
Q.10	**a.**	Describe with a neat sketch, the construction and working of L.V.D.T.	**10**	**L2**	**CO5**
	b.	Explain the principle of sine – bar with sketch. Also build the angle $37^\circ\ 9'\ 18''$ using angle gauges with sketch.	**10**	**L3**	**CO5**

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BME403

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
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 properties of fluids and mention their SI units: (i) Mass Density (ii) Specific weight (iii) Kinematic viscosity	06	L1	CO1
	b.	Calculate the dynamic viscosity of oil which is used for lubrication between a square plate of size 0.8 m × 0.8 m and an inclined plane with an angle of inclination 30°. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of the oil film is 1.5 mm.	08	L3	CO1
	c.	Calculate the capillary rise in a glass tube of 3.0 mm diameter when immersed vertically in (i) water and (ii) mercury. Take surface tensions for mercury and water as 0.0725 N/m and 0.52 N/m respectively in contact with air. Specific gravity for mercury is given as 13.6.	06	L3	CO1
		OR			
Q.2	a.	Distinguish between (i) Absolute pressure (ii) Gauge pressure (iii) Gauge vacuum (iv) Atmospheric pressure. Indicate their relative position on a chart.	06	L2	CO1
	b.	Derive an expression for the total pressure and the depth of centre of pressure for a inclined surface submerged in water.	08	L3	CO1
	c.	A square plate of 1.5 m side is immersed in water vertically. Find the hydrostatic force on the plate and the depth of centre of pressure from free surface of water. When its upper side is 0.5 m below the free surface of water.	06	L3	CO1
		Module – 2			
Q.3	a.	Define the following : (i) Steady and Unsteady flow (ii) Compressible and Incompressible flow (iii) Laminar and Turbulent flow	06	L2	CO2
	b.	Define the equation of continuity. Obtain an expression for continuity equation for a three-dimensional flow.	08	L3	CO2
	c.	The velocity components in a two-dimensional flow are : $u = 8x^2y - \frac{8}{3}y^3$ and $v = -8xy^2 + \frac{8}{3}x^3$ Show that these velocity component represent a possible case of an irrotational flow.	06	L3	CO2

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		OR			
Q.4	**a.**	Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow.	**08**	**L3**	**CO2**
	b.	A fluid of viscosity 0.5 poise and specific gravity 1.20 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 147.15 N/m^2. Find (i) The pressure gradient (ii) The average velocity (iii) The Reynolds number of the flow.	**08**	**L3**	**CO2**
	c.	Define Reynolds number. Explain its significance in fluid flow.	**04**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Derive Euler's equation of motion along a stream line. Obtain Bernoulli's equation from Euler's equation. Mention the assumptions made.	**08**	**L3**	**CO3**
	b.	Derive the expression for the rate of flow of fluid through a horizontal venturimeter.	**06**	**L3**	**CO3**
	c.	A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 14.715 N/cm^2 and vacuum pressure at the throat is 40 cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$.	**06**	**L3**	**CO3**
		OR			
Q.6	**a.**	Explain the procedure to find the loss of head due to friction in pipes using (i) Darcy formula and (ii) Chezy's formula.	**06**	**L2**	**CO3**
	b.	Obtain expression for head loss in a sudden expansion in the pipe. List all the assumptions made in the derivation.	**08**	**L3**	**CO3**
	c.	Calculate the rate of flow of water through a pipe of diameter 300 mm. When the difference of pressure head between the two ends of a pipe 400 m apart is 5 m of water. Take value of f = 0.009 in the formula. $h_f = \frac{4f1V^2}{d \times 2g}$	**06**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	What do you understand by the terms boundary layer and boundary layer theory?	**04**	**L1**	**CO4**
	b.	Define displacement thickness. Derive an expression for the displacement thickness.	**08**	**L3**	**CO4**
	c.	Oil with a free-stream velocity of 2 m/s flow over a thin plate 2 m wide and 2 m long. Calculate the boundary layer thickness and the shear stress at the trailing end point and determine the total surface resistance of the plate. Take specific gravity as 0.86 and kinematic viscosity as 10^{-5} m^2/s.	**08**	**L3**	**CO4**

		OR			
Q.8	**a.**	Explain the following terms: (i) Geometric similarity (ii) Kinematic similarity (iii) Dynamic similarity	**06**	**L2**	**CO4**
	b.	State Buckingham's π - theorem. What do you mean by repeating variables?	**06**	**L2**	**CO4**
	c.	The frictional torque 'T' of a disc of diameter 'D' rotating at a speed 'N' in a fluid of viscosity 'μ' and density 'ρ' in a turbulent flow is given by 'T'. Show that $T = D^5N^2\rho\phi\left[\frac{\mu}{\rho ND^2}\right]$	**08**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	State the Bernoulli's theorem for compressible flow. Derive an expression for Bernoulli's equation when the process is (i) Isothermal (ii) Adiabatic.	**10**	**L3**	**CO5**
	b.	Define Mach number. Explain its importance in compressible fluid flow.	**05**	**L2**	**CO5**
	c.	Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take R = 287.14 J/kg °K, take K for air 1.4. Assume temperature as 15°C.	**05**	**L3**	**CO5**
		OR			
Q.10	**a.**	What is CFD? Mention the advantages and disadvantages of CFD.	**08**	**L1**	**CO5**
	b.	What are the steps involved in solving a CFD problem? Explain.	**06**	**L2**	**CO5**
	c.	An aeroplane is flying at an height of 15 km, where the temperature is – 50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg °K. Find the speed of the plane.	**06**	**L3**	**CO5**

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BME405A

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025
Non Traditional Machining

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 Non-traditional Machining process. Also give the classification of non-traditional machining process based on different energy sources.	10	L1	CO1
	b.	Explain the need for non-traditional machining process.	10	L2	CO1
		OR			
Q.2	a.	Explain the selection of non-traditional machining process.	08	L2	CO2
	b.	What are the specific advantages , disadvantages and applications of non-traditional machining process.	12	L2	CO2
		Module – 2			
Q.3	a.	Write a neat sketch of Ultrasonic Machining (USM) process and label the important parts. Also explain principle of working.	12	L2	CO2
	b.	Discuss the process characteristics like material removal rate, tool wear, accuracy and surface finish of USM.	08	L2	CO3
		OR			
Q.4	a.	With a neat sketch explain working principle of Abrasive Jet Machining process.	12	L2	CO2
	b.	Explain the process variables in Abrasive Jet Machining process.	08	L1	CO2
		Module – 3			
Q.5	a.	With a neat sketch explain principle of working of Electro Chemical Machining process (ECM).	12	L2	CO2
	b.	Explain the process parameters of ECM like current density, tool feed rate, gap between tool and workpiece, flow rate of electrolyte.	08	L1	CO2
		OR			
Q.6	a.	With a neat sketch explain electrochemical honing process, also write advantages and limitations of the process.	08	L2	CO2
	b.	Explain the following with respect to chemical machining process: i) Chemical blanking process ii) Chemical Milling process	12	L2	CO2
		Module – 4			
Q.7	a.	With a neat sketch explain mechanism of metal removal in EDM process.	12	L1	CO4
	b.	What is Dielectric Fluid? Explain the desirable properties of a dielectric fluid medium used in EDM process. Also list the different dielectric fluids.	08	L2	CO4
		OR			
Q.8	a.	With a sketch explain working of Plasma Arc Machining process (PAM).	10	L2	CO4
	b.	Explain the safety precaution in PAM.	06	L2	CO4
	c.	Write the applications of EDM process.	04	L2	CO4
		Module – 5			
Q.9	a.	With a help of neat sketch explain working principle of Laser Beam Machining process (LBM).	12	L2	CO2
	b.	What are the advantages , limitations and applications of LBM.	08	L1	CO2
		OR			
Q.10	a.	With a neat sketch explain Electron Beam Machining process (EBM).	12	L2	CO2
	b.	What are the advantages , limitations and applications of EBM.	08	L1	CO2

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21ME53

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Finite Element Analysis

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Explain the basic steps involved in Finite Element Method. **(10 Marks)**

b. What are the advantages and disadvantages of Finite Element Method? **(10 Marks)**

OR

2 a. Explain plane stress and plane strain conditions. **(10 Marks)**

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

Module-2

3 a. Derive shape functions for 1D quadratic bar elements in natural coordinates. **(10 Marks)**

b. Derive shape functions for constant strain triangle in natural coordinates. **(10 Marks)**

OR

4 For the stepped bar shown in Fig.Q.4. Determine the nodal displacement and stressed at each node. **(20 Marks)**

Take

For element ①

$E_1 = 200$ GPa

For element ②

$E_2 = 70$ GPa

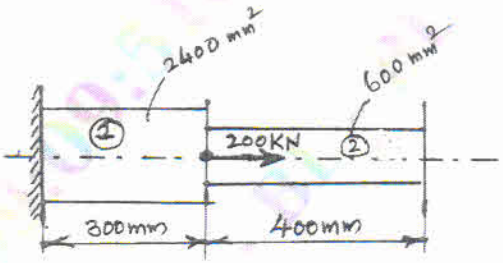

Fig.Q.4

Module-3

5 a. Derive H_1 and H_2 Hermite shape functions for beam elements. **(10 Marks)**

b. A cantilever beam subjected to point load of 250 kN as shown in Fig.Q.5(b). Determine the deflection at free end. Take E = 200 GPa, $I = 4 \times 10^6$ mm^4. **(10 Marks)**

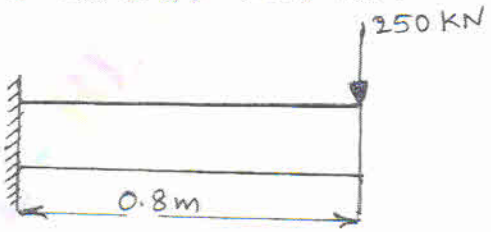

Fig.Q.5(b)

OR

6 a. Derive stiffness matrix equation for torsion of shaft. **(10 Marks)**

b. For the circular stepped shaft shown in Fig.Q.6(b). Determine stresses and angle of twist. Take : E = 200 GPa , G = 70 GPa **(10 Marks)**

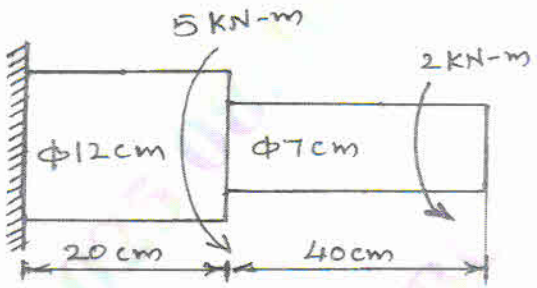

Fig.Q.6(b)

Module-4

7 a. Derive stiffness matrix or conductivity matrix for 1-D bar element. **(08 Marks)**

b. Determine the temperature distribution in the rectangular fin as shown in Fig.Q.7(b). Assume steady state and only conduction process. Take heat generated inside the fin as 400 W/m^2. **(12 Marks)**

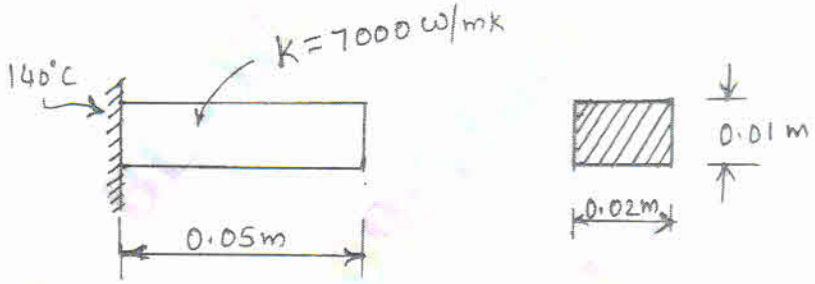

Fig.Q.7(b)

OR

8 For smooth pipe of variable cross section shown in Fig.Q.8. Determine the potential at the junctions, velocities in each section of pipe and volumetric flow rate. Potential at left end P_1 = 10 m^2/s, right end P_4 = 1 m^2/s. Fluid flow through the pipe K_s = 1. **(20 Marks)**

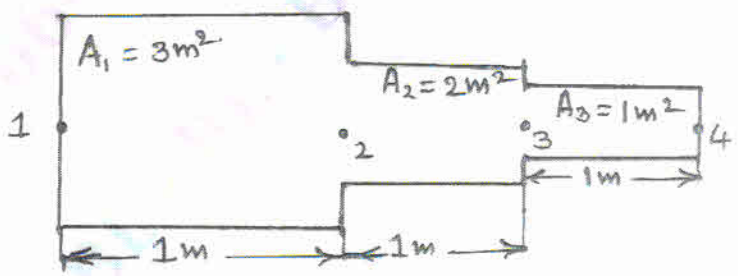

Fig.Q.8

Module-5

9 a. Derive stiffness matrix of axisymmetric bodies with triangular elements. **(12 Marks)**

b. For the element of an axisymmetric body rotating with a constant angular velocity w = 1000 rev/min as shown in Fig.Q.9(b). Determine the body force vector, include the weight of the material, where the specific density is 7850 kg/m^3. **(08 Marks)**

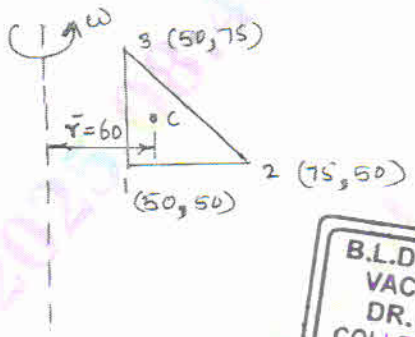

Fig.Q.9(b)

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OR

10 a. Derive the consistent mass matrix for 1-D bar element. **(10 Marks)**

b. Evaluate eigen values of longitudinal vibration of the constrained uniform circular bar shown in Fig.Q.10(b). Take minimum two elements and E = 210 GPa and ρ = 7860 kg/m^3. **(10 Marks)**

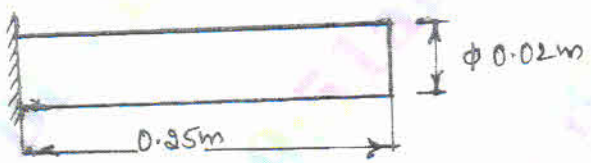

Fig.Q.10(b)

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21ME54

Fifth Semester B.E. B.Tech. Degree Examination, June/July 2025

Modern Mobility and Automotive Mechanics

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-2

3 a. Explain the working and construction of single plate clutch. (10 Marks)
b. With a neat sketch, explain the working of torque converter. (10 Marks)

OR

4 a. Explain any two types of rear axle. (10 Marks)
b. List and explain the construction and advantages of leaf spring. (10 Marks)

Module-3

5 a. Write a note on steering geometry. (10 Marks)
b. With a neat sketch, explain the working of mechanical brakes. (10 Marks)

OR

6 a. Sketch and explain hydraulic braking system. (10 Marks)
b. List and explain the safety measures in modern vehicles. (10 Marks)

Module-4

7 a. Briefly explain the exhaust gas pollutants and their effects on environment. (10 Marks)
b. List the advantages and disadvantages of hydrogen fuel cell. (10 Marks)

OR

8 a. What are Bio-fuels? List and explain the steps involved in producing Bio-ethanol. (10 Marks)
b. With a neat layout explain the various operating components of CNG vehicles. (10 Marks)

Module-5

9 a. With a neat sketch, explain the working principle of electric vehicle for a 4-wheeler. **(10 Marks)**

b. Differentiate electrical vehicles with conventional vehicles. **(10 Marks)**

OR

10 a. Sketch and explain the construction and working of lead acid battery. **(10 Marks)**

b. Write a note on battery cooling and fire safety measures in battery vehicles. **(10 Marks)**

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21RMI56

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Research Methodology and Intellectual Property Rights

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Describe the meaning of Research and the objectives of Engineering Research. **(10 Marks)**

b. Explain in brief the different types of Engineering Research. **(10 Marks)**

OR

2 a. In detail, explain the ethics in Engineering Research practice. **(10 Marks)**

b. Explain in brief the different types of Research Misconduct. **(10 Marks)**

Module-2

3 a. Explain briefly the bibliographic databases. **(10 Marks)**

b. Write a short note on :

i) Conceptualizing Research.

ii) Reading a Datasheet. **(10 Marks)**

OR

4 a. Explain the impact of titles and keywords on citation. **(10 Marks)**

b. Explain any two styles for citation. **(10 Marks)**

Module-3

5 a. Explain the role of Intellectual Property in the economic and cultural development of the society. **(10 Marks)**

b. Describe Patents and explain the conditions for obtaining a patent protection. **(10 Marks)**

OR

6 a. Briefly describe the national bodies dealing with Patent Affairs. **(10 Marks)**

b. Explain the different types of Patent Applications. **(10 Marks)**

Module-4

7 a. Briefly explain :

i) Classes of copyrights ii) Ownership of copyrights. **(10 Marks)**

b. Explain how copyrights can be transfer to a Publisher. **(10 Marks)**

OR

8 a. Describe trademark and write a note on eligibility criteria for trademark and designation of Trademark symbols. **(10 Marks)**

b. Explain the famous case Law between COCA – COLA company and BISLERI International Pvt. Ltd. **(10 Marks)**

Module-5

9 a. Describe Industrial design and explain the acts and laws to govern Industrial designs. **(10 Marks)**

b. Explain the famous case law : Apple INC. V/S Samsung Electronics Co. **(10 Marks)**

OR

10 a. Explain the procedure for GI Registration. **(10 Marks)**

b. Explain the case study of Curcuma (Turmeric) Plant. **(10 Marks)**

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21RMI56

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Research Methodology and Intellectual Property Rights

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Describe the meaning of Research and the objectives of Engineering Research. **(10 Marks)**

b. Explain in brief the different types of Engineering Research. **(10 Marks)**

OR

2 a. In detail, explain the ethics in Engineering Research practice. **(10 Marks)**

b. Explain in brief the different types of Research Misconduct. **(10 Marks)**

Module-2

3 a. Explain briefly the bibliographic databases. **(10 Marks)**

b. Write a short note on :

i) Conceptualizing Research.

ii) Reading a Datasheet. **(10 Marks)**

OR

4 a. Explain the impact of titles and keywords on citation. **(10 Marks)**

b. Explain any two styles for citation. **(10 Marks)**

Module-3

5 a. Explain the role of Intellectual Property in the economic and cultural development of the society. **(10 Marks)**

b. Describe Patents and explain the conditions for obtaining a patent protection. **(10 Marks)**

OR

6 a. Briefly describe the national bodies dealing with Patent Affairs. **(10 Marks)**

b. Explain the different types of Patent Applications. **(10 Marks)**

Module-4

7 a. Briefly explain :

i) Classes of copyrights ii) Ownership of copyrights. **(10 Marks)**

b. Explain how copyrights can be transfer to a Publisher. **(10 Marks)**

OR

8 a. Describe trademark and write a note on eligibility criteria for trademark and designation of Trademark symbols. **(10 Marks)**

b. Explain the famous case Law between COCA – COLA company and BISLERI International Pvt. Ltd. **(10 Marks)**

Module-5

9 a. Describe Industrial design and explain the acts and laws to govern Industrial designs. **(10 Marks)**

b. Explain the famous case law : Apple INC. V/S Samsung Electronics Co. **(10 Marks)**

OR

10 a. Explain the procedure for GI Registration. **(10 Marks)**

b. Explain the case study of Curcuma (Turmeric) Plant. **(10 Marks)**

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21ME61

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Production and Operations Management

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define operation management and explain operation management function, with block diagram. **(10 Marks)**

b. Differentiate between goods and services. **(10 Marks)**

OR

2 a. Explain the characteristics of operation decisions. **(10 Marks)**

b. Mention the frame work for decision making process. **(10 Marks)**

Module-2

3 a. Explain the elements of good forecast. **(10 Marks)**

b. Mention the steps involved in forecast process. **(10 Marks)**

OR

4 a. Explain long term, short term and intermediate forecasts. **(10 Marks)**

b. With the help of least-squares method, develop a linear trend equation for the data shown in the table and

i) Compute the constants a and b in the regression equation

ii) Forecast a trend value for the year 2002 and 2008.

Year	1991	92	93	94	95	96	97	98	99	2000	2001
Shipments (tones)	2	3	6	10	8	7	12	14	14	18	19

(10 Marks)

Module-3

5 a. Explain the importance of capacity decisions. **(10 Marks)**

b. Explain measuring capacity with examples. **(10 Marks)**

OR

6 a. Name the different types of processing layouts and explain any two. **(10 Marks)**

b. Explain the need for layout decisions. **(10 Marks)**

Module-4

7 a. Explain purpose and scope of aggregate planning. **(10 Marks)**

b. Name the different strategies involved in aggregate planning. **(10 Marks)**

OR

8 a. What are the objectives of master scheduling process? **(10 Marks)**

b. Mention the planning horizon of master schedule. **(10 Marks)**

Module-5

9 a. Mention the benefits in material requirement planning. **(10 Marks)**

b. Explain briefly MRP inputs. **(10 Marks)**

OR

10 a. Explain the importance of purchasing in supply chain management. **(10 Marks)**

b. Define tender and mention the approaches to supply chain management. **(10 Marks)**

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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21ME62

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note:

1. **Answer any FIVE full questions, selecting one Full question from each module.**
2. **Use of Heat transfer Data hand book, Thermodyamics Data hand Book, and steam tables are permitted.**
3. **Assume missing data suitably.**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. What are three ways heat is transferred? In brief explain them. **(05 Marks)**

b. What are boundary conditions? Explain any one of the boundary conditions with a sketch. **(05Marks)**

c. Derive the general three – dimensional unsteady state heat condition equation with heat generation, in a Cartesian coordinate system for an isotropic material with assumptions made. **(10 Marks)**

OR

2 a. Find the heat flow rate through the composite wall as shown in Fig.Q2(a). Assume one – dimensional flow. $K_a = 150$ w/m°C, $K_b = 30$ w/ m°C, $K_c = 65$ w/ m°C, $K_d = 50$ w/ m°C.

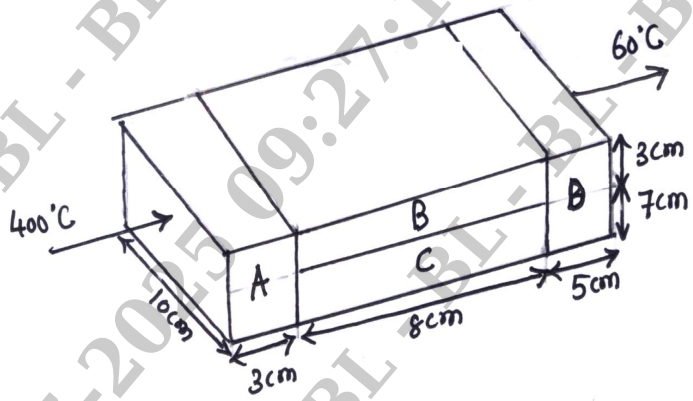

Fig. Q2(a)

(10 Marks)

b. Explain the experimental method of determining the thermal conductivity of a metal rod. **(10 Marks)**

Module-2

3 a. Define Fin, and list the common types of fin configurations. Write a note on any two types of fin with a neat sketch. **(05Marks)**

b. Define Efficiency of fin and Effectiveness of fin. In brief discuss on both. **(05 Marks)**

c. With assumptions, derive an expression for temperature distribution and rate of heat transfer for an infinitely long fin. **(10 Marks)**

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OR

4 a. Write a note on transient heat conduction. How to analyze transient heat flow? **(05 Marks)**

b. Write a note on Biot number and Fourier number with their significance on transient heat conduction. **(05 Marks)**

c. A steel ball of 5 cm diameter at 450°C is suddenly placed in a controlled environment of 100°C Considering the following data, find the time required for the ball to attain a temperature of 150°C. Take C_ρ= 450 J/kg–K, K = 35 w/mk, h = 10 w/m^2-k, ρ = 8000 kg/m^3. **(10 Marks)**

Module-3

5 a. Differentiate between the experimental, analytical and numerical methods of determining the solution of a heat transfer problem. **(10 Marks)**

b. Explain the finite difference formulation of the differential equation of one – dimensional steady heat conduction. **(10 Marks)**

OR

6 a. State :
i) Emissivity
ii) Stefan Boltzmann's law
iii) Kirchoff's law
iv) Plank's law
v) Wein displacement law **(10 Marks)**

b. Write a brief note on the Radiation shape factor ad Radiation shields. **(10 Marks)**

Module-4

7 a. With neat sketches, explain velocity boundary layer and thermal boundary layer over flat plate. **(10 Marks)**

b. With assumptions derive an expression for Nusselt's number in terms of Reynold's number and Prandtl's number for forced convection. **(10 Marks)**

OR

8 a. Define the following terms with their significance.
i) Reynolds number
ii) Nusselt number
iii) Prandtl number
iv) Laminar flow
v) Turbulent flow. **(10 Marks)**

b. Air at 20°C and at atmospheric pressure flows over a flat plate at a velocity of 1.8 m/s. If the length of the plate is 2.2 m and is maintained at 100°C, calculate the heat transfer rate per unit width using the properties of air at mean bulk temperature of $\left(\frac{100+20}{2}\right) = 60\,°C$

are ρ = 1.06 kg/m^3, $C\rho = 1.005 \frac{KJ}{Kg}$, $K = 0.02894 \frac{W}{m^\circ C}$,

$P_r = 0.696$, $\nu = 18.97 \times 10^{-6} \frac{m^2}{S}$. **(10 Marks)**

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Module-5

9 a. Discuss the regimes of pool boiling curve for water. **(10 Marks)**

b. Saturated steam at t_{sat} = 90°C (ρ = 70.14 KPa) condenses on the outer surface of a 1.5 m long 2.5 m OD vertical tube maintained at a temperature T_{∞} = 70°C. Assuming film condensation calculate :

1) The local transfer coefficient at the bottom of the tube.

2) The average heat transfer coefficient over the entire length of the tube.

Properties of water at 80°C are $\rho_l = 974$ kg/m^3, $K_t = 0.668$ w/mk, $\mu_l = 0.335 \times 10^3$ kg/ms, h_{fg}= 2309 kJ/kg, $\rho_v << \rho_r$. **(10 Marks)**

10 a. Define heat Exchanger and Logarithmic Mean Temperature difference. Differentiate between parallel and counter –flow heat exchangers. **(10 Marks)**

b. In a counter flow double pipe heat exchanger, water is heated from 25°C to 65°C by an oil with a specific heat of 1.45 kJ/kg and mass flow rate of 0.9 kg/s. The oil is cooled from 230°C to 160°C. If the overall heat transfer coefficient is 420 w/m°C, calculate the following :

i) the rate of heat transfer

ii) the mass flow rate of water and

iii) the surface area of the heat Exchanger. **(10 Marks)**

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21ME63

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Machine Design

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of design data hand book is permitted.
3. Assume missing data suitably.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Explain the following:
i) Elasticity
ii) Plasticity
iii) Ductility
iv) Brittleness
v) Factor of safety. **(10 Marks)**

b. Determine the required thickness of the steel bracket at section A-A when loaded as shown in Fig.Q.1(b) in order to limit the tensile stress to 100 N/mm^2. **(10 Marks)**

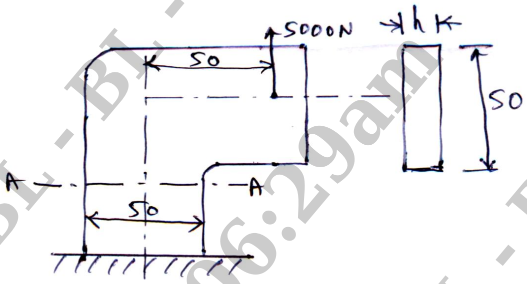

Fig.Q.1(b)

OR

2 a. A notched flat plate shown in Fig.Q.2(a) is subjected to bending moment of 10 N.m. Determine the maximum stress induced in the member by taking the stress concentration into account. **(10 Marks)**

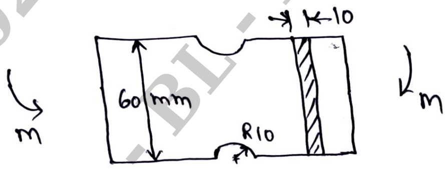

Fig.Q.2(a)

b. Derive an equation for impact stress induced in a member subjected to axial impact loading. **(10 Marks)**

Module-2

3 a. With usual notations prove that a hollow shaft is always stronger than a solid shaft of the same material, weight and length when subjected to simple torque and hence deduce that

$$\frac{\text{Torque on hollow shaft}}{\text{Torque on solid shaft}} = \frac{1+k^2}{\sqrt{1-k^2}} > 1, \text{ where } k = \frac{D_i}{D_o}$$ **(14 Marks)**

b. A shaft is required to transmit 1 MW at 240 rpm. The shaft must not twist more than 1° on a length of 15 diameters. If the modulus of rigidity for the shaft material is 80 kN/mm^2, find diameter of the shaft. **(06 Marks)**

OR

4 a. Write design procedure for flange coupling. **(08 Marks)**

b. Design a value spring for an automobile engine, when the value is closed, the spring produces a force of 45 N and when it opens, produces a force of 55 N. The spring must fit over the value bush which has an outside diameter of 20 mm and must go inside a space of 35 mm. The lift of the value is 6 mm. The spring index is 12. The allowable stress may be taken as 0.33 GPa, modulus of rigidity 80 Gpa. **(12 Marks)**

Module-3

5 a. Sketch and explain failure modes of riveted joints. **(08 Marks)**

b. 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. **(12 Marks)**

OR

6 a. A plate of 80 mm wide and 10 mm thick is to be welded to another plate by means of two parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of weld so that maximum stress does not exceed 50 N/mm^2. Consider the joint under static loading and then under dynamic loading. **(10 Marks)**

b. A flat circular plate is used to close the flanged end of a pressure vessel of internal diameter 300 mm. The vessel carries a fluid at a pressure of 0.7 N/mm^2. A soft copper gasket is used to make the joint leak proof. Twelve bolts are used to fasten the cover plate onto the pressure vessel. Find the size of bolts so that the stress in the bolts is not to exceed 100 N/mm^2. **(10 Marks)**

Module-4

7 A pair of carefully cut spur gears with 20° full depth involute profile 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 of spur pinion and gear. Suggest suitable hardness. Take 24 teeth on pinion, modulus of elasticity may be taken as 210 GPa. **(20 Marks)**

OR

8 a. Derive an equation for formative or virtual or equivalent number of teeth for bevel gear. **(08 Marks)**

b. Following data refer to a worm and worm gear drive centre distance 200 mm, PCD of worm 80 mm, number of start 44, axial module 8 mm, transmission ratio 20, worm gear is phosphor bronze with σ_{au} 55 MPa, worm is of hardened ground steel, tooth form 20° FD involute. Determine following:
Number of teeth on worm gear, lead angle face width of worm gear to transmit 15 kW of power at 1750 rpm of worm based on the beam strength of worm gear. **(12 Marks)**

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Module-5

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 Marks)**

b. A single block brake is shown in Fig.Q.9(b). The drum diameter is 250 mm. The contact angle is 90°. If an operating force of 700 N is applied at the end of the lever and the coefficient of friction is 0.35, determine the torque that may be sustained by the brake. **(10 Marks)**

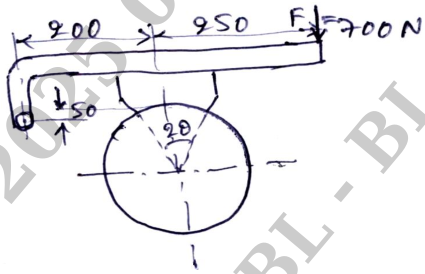

Fig.Q.9(b)

OR

10 a. Explain hydrodynamic theory of lubrication with sketch. Pressure distribution in bearing and graph showing variation of friction with speed. **(10 Marks)**

b. A single row deep groove ball bearing has a specific dynamic capacity of 46.3 kN. The actual radial load F_r = 9 kN. The speed of rotation is 1800 rpm. What is the life in i) Cycles of operation ii) in hours iii) What is average life? **(10 Marks)**

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21ME652

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025

Renewable Energy Power Plants

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Briefly explain energy resources and its classifications. **(06 Marks)**
b. What is the need of non-conventional energy sources. **(06 Marks)**
c. Briefly describe energy alternatives : i) Photovoltaic ii) Tar Sand and oil shale. **(08 Marks)**

OR

2 a. With a neat sketch explain : i) Sunshine recorder ii) Pyranometer. **(08 Marks)**
b. Distinguish between beam and diffused radiations. **(06 Marks)**
c. Explain terrestrial and extra terrestrial radiations. **(06 Marks)**

Module-2

3 a. Define : i) Solar latitude ii) Declination angle iii) Zenith angle iv) Surface aziniuth angle v) Hour angle. **(10 Marks)**
b. With neat sketch explain any two types of concentrating collectors. **(10 Marks)**

OR

4 a. Explain with sketch : i) Solar distillation ii) Solar pond. **(10 Marks)**
b. With a neat sketch, explain photovoltaic conversion. Given one application of solar cell. **(10 Marks)**

Module-3

5 a. List the types of wind mill. Explain with sketch horizontal axis wind mill. **(10 Marks)**
b. Explain with neat sketch Savonius and derricus types of vertical axis wind turbines. **(10 Marks)**

OR

6 a. With a neat sketch explain fixed dome type biogas plant. **(10 Marks)**
b. What are the problems associated in bio-gas production. **(10 Marks)**

Module-4

7 a. With a neat sketch explain Hydel power plant. **(10 Marks)**
b. With a neat sketch explain use of : i) Hydrographs ii) Flow duration curves. **(10 Marks)**

OR

8 a. With the help of diagram, explain two basin systems in tidal power harnessing. **(10 Marks)**
b. List the advantages and disadvantages of tidal plants. **(10 Marks)**

Module-5

9 a. Describe the closed cycle OTEC system with the help of diagram. **(10 Marks)**
b. What are the problems associated with OTEC. **(10 Marks)**

OR

10 a. With a neat sketch explain dry steam based geothermal power plant. **(10 Marks)**
b. List the advantages and disadvantages geo-thermal energy. **(10 Marks)**

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21ME653

Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Mechatrnoics

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define Mechatronics. Explain with an example elements of measurement system. **(07 Marks)**
b. Explain with block diagram, basic elements of a closed –loop control system. **(08 Marks)**
c. List the requirements and types of a control system. **(05 Marks)**

OR

2 a. Illustrate working of potentiometer and LVDT. **(07 Marks)**
b. Explain capacitance sensors and temperature sensors. **(08 Marks)**
c. Comparison between Transducer and Sensor. **(05 Marks)**

Module-2

3 a. Explain Data Acquisition System (DAQS). **(07 Marks)**
b. Explain in detail Supervisory Control and Data Acquisition (SCADA). **(08 Marks)**
c. Explain briefly Registers and Capacitors. **(05 Marks)**

OR

4 a. Explain briefly stepper motor. **(07 Marks)**
b. Explain DC brushless motors with field coils with a neat sketch. **(08 Marks)**
c. Explain Pulse Width Modulation (PWM). **(05 Marks)**

Module-3

5 a. With a neat block diagram, explain different components and its functionalities of micro controller. **(07 Marks)**
b. List and explain basic elements of control system. **(08 Marks)**
c. Differentiate between micro processor and microcontroller. **(05 Marks)**

OR

6 a. With a neat sketch explain architectures of Intel's 8085 microprocessor. **(07 Marks)**
b. What is Micro Controller? Explain the classification of micro controller. **(08 Marks)**
c. Define Microprocessor and explain briefly. **(05 Marks)**

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Module-4

7 a. Sketch and explain basic structure of Programmable Logic Controller (PLC). **(07 Marks)**

b. Write short notes on shift registers and Tump control. **(08 Marks)**

c. Explain the criteria that need to be considered for selection of a Programmable Logic Control (PLC). **(05 Marks)**

OR

8 a. Explain the control of two pneumatic piston, with a neat sketch. **(07 Marks)**

b. Explain the control of convegormotor, with a neat sketch. **(08 Marks)**

c. Write short notes on Timers with a ladder diagram. **(05 Marks)**

Module-5

9 a. Explain construction and working of any one linear motion guide ways with neat sketch. **(07 Marks)**

b. With block diagram, explain elements of open loop and closed loop control system. **(08 Marks)**

c. With block diagram, explain adaptive control for machine tools with constraints. **(05 Marks)**

OR

10 a. Explain the stage of design process. **(07 Marks)**

b. Explain the comparison between traditional and mechatronics design concepts. **(08 Marks)**

c. Explain any one case studies of mechantronic systems. **(05 Marks)**

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21ME71

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
Automation and Robotics

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define Automation. Explain basic elements of an automated system. **(10 Marks)**
b. Explain the levels of automation process. **(10 Marks)**

OR

2 a. Explain continuous control system. **(10 Marks)**
b. Explain with neat sketch Digital-to-Analog conversion. **(10 Marks)**

Module-2

3 a. Explain fundamentals of automated production line. **(10 Marks)**
b. Explain the analysis of transfer lines. **(10 Marks)**

OR

4 a. Explain the linear transfer system. **(10 Marks)**
b. Explain :
i) Barcode Technology
ii) Radio frequency identification. **(10 Marks)**

Module-3

5 a. Explain with neat sketch Robot anatomy. **(10 Marks)**
b. List robot application in industries. **(10 Marks)**

OR

6 a. Explain : i) Accuracy ii) Repeatability. **(10 Marks)**
b. Explain Asimov's law of robotics. **(10 Marks)**

Module-4

7 a. Explain with neat sketch hydraulic actuators. **(10 Marks)**
b. Explain with neat sketch stepper motors. **(10 Marks)**

OR

8 a. Explain : i) Tactile sensors ii) Proximity Sensors. **(10 Marks)**
b. Explain forward and inverse kinematics. **(10 Marks)**

Module-5

9 a. Explain in levels of robot programming. **(10 Marks)**
b. What are the requirements of a robot programming language? **(10 Marks)**

OR

10 a. Explain off line programming systems. **(10 Marks)**
b. Explain in central issues in OLP systems. **(10 Marks)**

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21ME72

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
Control Engineering

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Explain open loop and closed loop system with block diagram and examples. **(10 Marks)**

b. Explain : (i) Proportional control action.
(ii) Differential control action. **(10 Marks)**

OR

2 a. Define control system. Explain basic terminologies involved in developing it. **(08 Marks)**

b. Find the transfer function $\frac{X_2(s)}{F(s)}$ for the given mechanical system. Refer Fig.Q2 (b).

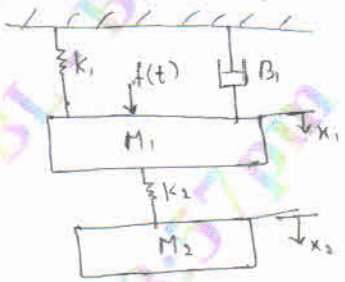

Fig. Q2 (b) **(12 Marks)**

Module-2

3 a. List and explain standard Test Inputs used in control system analysis. **(10 Marks)**

b. Explain 1st order system subjected to unit step input. **(10 Marks)**

OR

4 a. Examine a 2nd order under damped system subjected to unit step input. **(10 Marks)**

b. Identify the following quantities for 2nd order unit feedback system with open loop transfer function $G(s)H(s) = \frac{361}{s^2 + 16s + 361}$. Find

(i) Damping ratio
(ii) Natural frequency
(iii) Settling time
(iv) Peak time
(v) Peak over shoot. **(10 Marks)**

Module-3

5 a. List and explain rules of block diagram reduction technique. **(10 Marks)**

b. Develop a closed loop transfer function for the block diagram shown in Fig. Q5 (b).

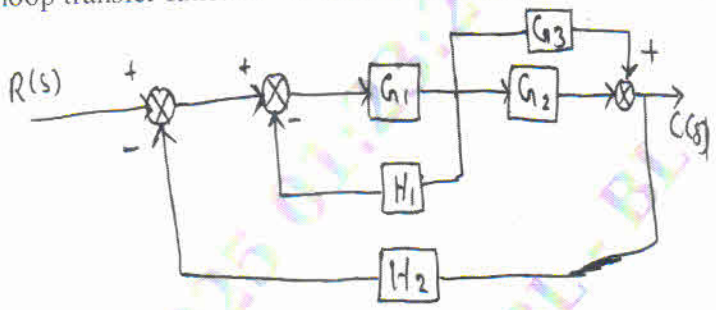

Fig. Q5 (b) **(10 Marks)**

OR

6 a. For the system shown in Fig. Q6 (a). Examine $\frac{C(s)}{R(s)}$ using Mason's gain formula.

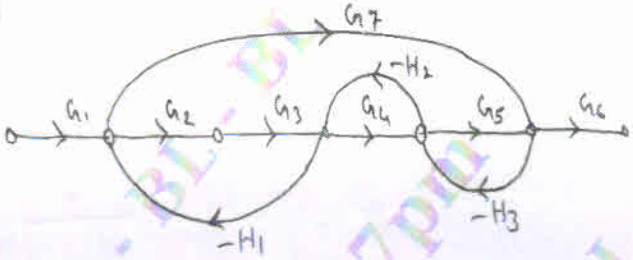

Fig. Q6 (a) **(10 Marks)**

b. For the system shown in Fig. Q6 (b), determine $\frac{C(s)}{R(s)}$ using Mason's gain formula.

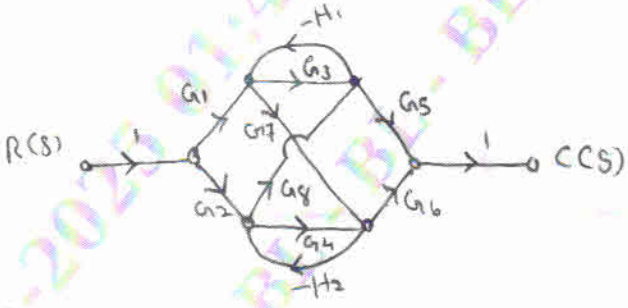

Fig. Q6 (b) **(10 Marks)**

Module-4

7 a. A system oscillates with a frequency 'w' if it has poles at $s = \pm j\omega$ and no poles in the right half of the s-plane. Determine the values of 'K' and 'a' so that the system shown in Fig. Q7 (a) below, oscillates at a frequency of 2 rad/sec.

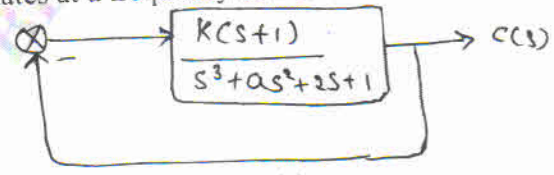

Fig. Q7 (a) **(10 Marks)**

b. The open loop T.F of a unit F.B control system is given by, $G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+2s)}$.

Determine the range of values of K for system stability. What is the value of K which gives sustained oscillations? What is the oscillation frequency? **(10 Marks)**

OR

8 Construct a root locus for all values of 'K' ranging from 0 to ∞ for a feedback control system characterized by,

$G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$. **(20 Marks)**

Module-5

9 Using Nyquist criterion, examine the stability of a system whose open loop transfer function is, $G(s)H(s) = \frac{K}{(s+1)(s+2)}$. **(20 Marks)**

OR

10 Construct a Bode plot for the following transfer function and determine gain margin and phase margin.

$G(s)H(s) = \frac{50}{s(0.5s+1)(0.05s+1)}$. **(20 Marks)**

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CBCS SCHEME

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21ME732

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
Total Quality Management

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define TQM. Explain six basic concepts of TQM. **(10 Marks)**
b. Explain contribution made by any two Guru's. **(10 Marks)**

OR

2 a. Draw and Explain the TQM. Framework. **(10 Marks)**
b. What is QMS ? Explain different services of ISO 9000 standards. **(10Marks)**

Module-2

3 a. Explain the role of TQM leaders. **(10Marks)**
b. List Deming's 14 points and Explain any one. **(10 Marks)**

OR

4 a. Explain briefly the seven characteristics of effective people. **(10 Marks)**
b. What are the duties of Quality Control. **(10 Marks)**

Module-3

5 a. State and explain elements of customers service. **(10 Marks)**
b. Explain with neat sketch the Kano Model. **(10 Marks)**

OR

6 a. Define the following :
i) Motivation
ii) Employee surveys
iii) Empowerment
iv) Reward
v) Teams. **(10Marks)**
b. Explain the role of employee's investment in customer satisfaction. **(10Marks)**

Module-4

7 a. Explain cause and effect diagram with an Example. **(10 Marks)**
b. Sketch and Explain Juran's Triology. **(10 Marks)**

OR

8 a. Write note on i) Six- Sigma ii) Reengineering. **(10Marks)**
b. Explain PDSA cycle for continuous improvement with a neat figure. **(10 Marks)**

Module-5

9 a. Define Quality by design ? What are its key components ? (10 Marks)
b. List and Explain the steps involved in introduction of TPM. (10 Marks)

OR

10 a. Explain the basic elements of EMS under ISO 14001. (10 Marks)
b. Which are the 8 pillars of TPM ? Describe them with a neat sketch. (10 Marks)

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CBCS SCHEME

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21ME753

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
Operations Research

Time: 3 hrs. Max. Marks: 100

Note : 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Statistical table permitted.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Discuss the various phases of OR. **(06 Marks)**

b. A manufacturer produces 3 models A, B and C of a certain product using raw materials X and Y. The following tables gives the data :

Raw Materials	Requirement per unit			Availability
	A	B	C	
X	2	3	5	4000
Y	4	2	7	6000
Minimum demand	20	200	150	-
Profit / Unit	30	20	50	-

Formulate the above as LPP to maximize the profit. **(14 Marks)**

OR

2 a. Discuss the scope of Operation Research in management across different functional areas. **(05 Marks)**

b. Find the maximum value of the following LPP model , using graphical method :
$Z = 2x_1 + 3x_2$ of the following LPP model.
Subject to $x_1 + x_2 \leq 30$
$x_2 \geq 3$
$x_2 \leq 12$
$x_1 - x_2 \geq 0$
$0 \leq x_1 \leq 20$. **(15 Marks)**

Module-2

3 a. Explain the following i) basic feasible solution ii) degenerate basic feasible solution iii) unbounded solution. **(06 Marks)**

b. Solve by simplex method the following L.P problem :
Maximize $Z = 4x_1 + 3x_2 + 6x_3$
Subject to $2x_1 + 3x_2 + 6x_3 \leq 440$
$4x_1 + 3x_3 \leq 470$
$2x_1 + 5x_2 \leq 430$
$x_1, x_2, x_3 \geq 0$. **(14 Marks)**

OR

4 a. Describe the canonical and standard form of LPP with their characteristics. **(06 Marks)**

b. Food X contains 6 units of vitamin A per gram and 7 units of vitamin B per gram and costs 12 paise per gram. Food Y contains 8 units of vitamin A per gram and 12 units of vitamin B per gram and costs 20 paise per gram. The daily minimum requirements of vitamin A and vitamin B is 100 units and 200 units respectively. Find the minimum cost of product mix using Big M method. **(14 Marks)**

Module-3

5 A company has 3 factories manufacturing the same product and 5 sales agencies in different parts of the Country. Product costs differ from factory to factory and the selling prices from agency to agency. The shipping cost per unit product from each factory to each agency is known. Given the following data :

i) Formulate this problem as a transportation problem in order to maximize profit.
ii) Find the solution using VAM method.
iii) Test for optimality and find the optimal solution.

Factory i	Production cost/unit (Rs)	Maximum capacity (No. of units)
1	18	140
2	20	190
3	16	115

Factory i	1	2	2	6	10	5
	2	10	8	9	4	7
	3	5	6	4	3	8
Agency j		1	2	3	4	5
Demand		74	94	69	39	119
Selling price , Rs		35	37	36	39	34

Shipping cost (Rs)

(20 Marks)

OR

6 a. Differentiate between balanced and unbalanced transportation problems with example for each. **(05 Marks)**

b. Solve the following assignment problem :

	I	II	III	IV	V
1	11	17	8	16	20
2	9	7	12	6	15
3	13	16	15	12	16
4	21	24	17	28	26
5	14	10	12	11	13

(15 Marks)

Module-4

7 a. The utility data for a network diagram are given below. Determine the total , free, independent and interfering floats and also identify critical path. **(14 Marks)**

Activity	0-1	1-2	1-3	2-4	2-5	3-4	3-6	4-7	5-7	6-7
Duration	2	8	10	6	3	3	7	5	2	8

b. For the following project draw the network and trace the critical path.

Activity	0-1	1-2	1-3	1-4	2-3	3-4	4-5
Duration	3	6	16	10	8	5	3

(06 Marks)

OR

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8 a. The time estimates (in weeks) for the activities of a PERT network are given below :

Activity	1-2	1-3	1-4	2-5	3-5	4-6	5-6
t_o	1	1	2	1	2	2	3
t_m	1	4	2	1	5	5	6
t_p	7	7	8	1	14	8	15

i) Draw the project network and identify all the paths through it.
ii) Determine the expected project length.
iii) Calculate the standard deviation and variance of the project length.
iv) What is the probability that the project will be completed at least 4 weeks earlier than expected time?
v) Find the probability that the project will be completed on schedule if the scheduled completion time is 20 weeks. **(10 Marks)**

b. A person repairing radios find that the time spent on the radio sets has exponential distribution with mean 20 minutes. If the radios are repaired in the order in which they come in and their arrival is approximately Poisson with an average rate of 15 for 8 – hour day, what is the repairman's expected idle time each day? How many job are ahead of the average set just brought in. **(10 Marks)**

Module-5

9 a. Define Game , Optimal strategy , Zero sum game and Strategy. **(06 Marks)**

b. Solve the given game by Graphical method as shown below :

	y_1	y_2	y_3	y_4
x_1	19	6	7	5
x_2	7	3	14	6
x_3	12	8	18	4
x_4	8	7	13	-1

(14 Marks)

OR

10 a. Use graphical method to minimize the time required to process the following jobs on the machines. For each machine specify the job which should be done first. Also calculate the total elapsed time to complete both jobs. **(10 Marks)**

Job 1	Sequence :	A	B	C	D	E
	Time (hr) :	6	8	4	12	4
Job 2	Sequence :	B	C	A	D	E
	Time (hr) :	10	8	6	4	12

b. A refrigeration company has six plants located in different parts of a city. Every year it is necessary for each plant to be completely overhauled. The overhauling is carried out in two stages A and B and each stage requires a crew of workmen with completely different skills. The work on stage B can start only when stage A has been completed. The plant has to be closed for the entire period of the overhauling. The company at present is following the schedule of the overhaul of the six plants as given below :

Time required by the crew (days)

Plant	P_1	P_2	P_3	P_4	P_5	P_6
Crew A	12	9	10	8	10	10
Crew B	10	7	9	14	6	8

i) Determine the optimal sequence.

ii) If downtime of any of the six plant costs Rs 5,000 per day , idle time for crew A costs Rs 1500 per day and idle time for crew B costs Rs 2500 per day, which of the two schedules, the present one or the one determined in part (i) will be more economical? What are their respective costs? **(10 Marks)**

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