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B.M.S. College of Engineering, Bengaluru-560019

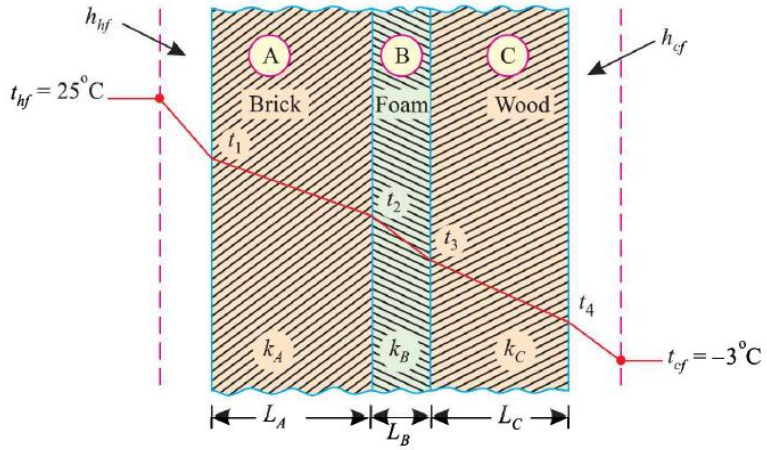
Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 16ME5DCFHT **Max Marks: 100**
Course: Fundamentals of Heat Transfer

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Heat and mass Transfer Data book is permitted

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Discuss the conduction mechanism in the solid, liquid and a gas.	CO1	PO1	**04**
	b)	Derive three dimensional heat conduction equation for Cartesian co-ordinates.	CO1	PO1	**08**
	c)	 **Figure 1.** A cold storage room has walls made of 220mm of brick on the outside, 90mm of plastic foam, and finally 16mm of wood on the inside. The outside and inside temperatures are 25 ºC and -3 ºC respectively. If the inside and outside heat tranfer coefficents are respectively 30 and 11 W/m^2 ºC, and the thermal conductivities of brick, foam and wood are 0.99, 0.022 and 0.17 W/m ºC respectively. Determine : (i) The rate of heat removal by refrigerartion if the total wall area is 85 m^2, (ii) The temperature of the inside surface of the brick.	CO2	PO2	**08**
		OR			
2	a)	Considering the general equation for heat flow through a rectangular fin, derive an expression for heat dissipation from a fin with infinite long boundary conditions.	CO2	PO1	**08**

		b)	Derive the equations for lumped capacitance analysis and obtain the temperature distribution in terms of Biot and Fourier numbers.	*CO3*	*PO1*	**06**
		c)	A solid copper sphere of 10 cm diameter [ρ=8954 kg/m^3 ; Cp = 383J/kg K, k= 386 W/mK]. Initially at a uniform temperature t_i = 250ºC, is suddenly immersed in a well stirred fluid which is maintained at a uniform temperature ta = 50ºC. The heat transfer co-efficient between sphere and fluid is h = 200 W/m^{2}K. Determine the temperature of copper block at τ= 5 min after the immersion.	*CO3*	*PO2*	**06**
			UNIT - II			
	3	a)	Explain velocity and thermal boundary layer for external flows.	*CO4*	*PO2*	**06**
		b)	Write the physical significances of the Prandtl number, Nussel number and Reynold Number.	*CO4*	*PO2*	**06**
		c)	Air at 20 ºC 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 ºC, calculate the heat transfer rate per unit width using (i) exact and (ii) approximate methods.	*CO4*	*PO2*	**08**
			OR			
	4	a)	Discuss the concept of velocity boundary layer and thermal boundary layer for internal flows.	*CO4*	*PO1*	**06**
		b)	In a straight tube of 60mm diameter, water is flowing at a velocity of 12 m/s. the tube surface temperature is maintained at 70 ºC and the flowing water is heated from the inlet temperature 15 ºC to an outlet temperature of 45 ºC. Taking the physical properties of water at its mean bulk temperature, calculate the following: (i) the heat transfer co-efficient from the tube surface to the water, (ii) The heat transferred, and (iii) The length of the tube.	*CO4*	*PO2*	**10**
		c)	Draw the temperature profile for constant temperature and constant heat flux conditions.	*CO4*	*PO2*	**04**
			UNIT - III			
	5	a)	The maximum allowable surface temperature of an electrically heated vertical plate 15cm high and 10cm wide is 140°C. Estimate the maximum rate of heat dissipation from both side of the plate in an atmosphere at 20 °C. The radiation heat transfer co-efficient s 8.72 W/m^{2}K. For air at 80°C, take ν =21.09 x 10^{-4} m^2/s, Pr = 0.692 and k= 0.03 W/mk.	*CO4*	*PO3*	**10**
		b)	A 50cm long fine wire of 0.02 mm diameter is maintained constant at 54°C by an electric current when exposed to air at 0°C. Find the electric power necessary to maintain the wire at 54°C.	*CO4*	*PO2*	**06**
		c)	Draw the temperature and velocity profile for constant temperature for vertical geometry.	*CO4*	*PO2*	**04**

			UNIT - IV			
	6	a)	State and explain followings: i) Stefan Boltzmann's law, ii) Plane and Solid Angle iii) Radiation of black body as a function of wavelength and temperature iv) Radiation shield	*CO5*	*PO1*	**10**
		b)	With figure explain distinct characteristics of black body radiation for $(E_\lambda)_b$ is a function of temperature and wavelength and also deduce the condition for the maximum monochromatic emissive power for the black body.	*CO5*	*PO2*	**10**
			UNIT - V			
	7	a)	Derive an expression for effectiveness by NTU method for parallel flow heat exchanger.	*CO6*	*PO1*	**10**
		b)	In a certain double pipe heat exchanger hot water flows at a rate of 5000 kg/h and gets cooled from 95°C to 65°C. At the same time 50000 kg/h of cooling water at 30°C enters the heat exchangers. The flow conditions are such that overall heat transfer co-efficient remains constant at 2270 W/m^2K. Determine the heat transfer area required and effectiveness, assuming two streams are in parallel flow. Assume for the both streams Cp = 4.2 kJ/kgK	*CO6*	*PO3*	**10**

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Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCCCR **Max Marks: 100**
Course: CAD/CAM and Robotics

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1	a)	With the help of classification, elaborate on CAD/CAM software tools.	**08**
	b)	Briefly explain CAD/CAM system with and without graphics standards.	**06**
	c)	What is the need for homogeneous representation of transformation? Write homogeneous transformation matrices for translation and rotation in 3D.	**06**

UNIT - II

2	a)	The coordinates of four control points are given by: P0 = [2 2 0], P1 = [2 3 0], P2 = [3 3 0] and P3 = [3 2 0]. Determine the equation of the resulting Bezier curve. Also find points on the curve for u = 0, ¼, ½, ¾ and 1	**12**
	b)	Explain the properties of: a) Bezier curves b) B-Spline curves	**08**

OR

3	a)	With the help of sketches, explain different types of surface entities available for surface modelling.	**10**
	b)	Elaborate on B-rep solid modelling and its validation using Euler's law.	**10**

UNIT - III

4	a)	Explain the architecture (with block diagram) and any one actuation systems of CNC machine.	**10**
	b)	Explain automatic tool changer (ATC) procedure and its types.	**10**

UNIT - IV

5	a)	Write APT program for the component shown in the Figure 5a.	**10**

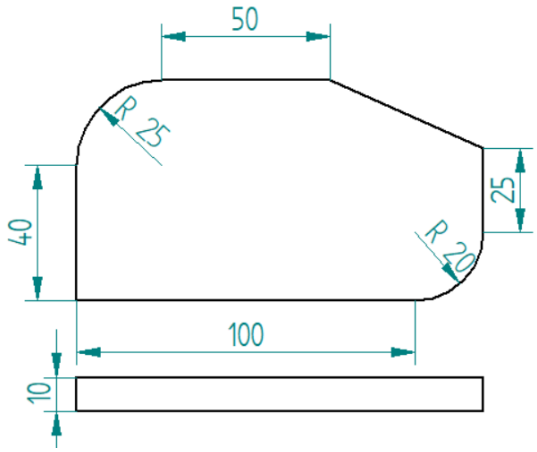

Figure 5a

b) Write manual part program for the component shown in the Figure 5b. Explain each line of the program. **10**

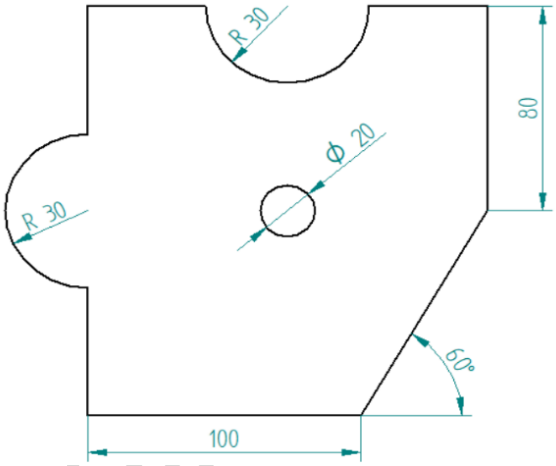

Figure 5b

UNIT - V

6 a) Briefly explain Importance of Robotics in automation and few other applications of robot. **06**

b) Explain Four basic configurations of Robot. **08**

c) Write a short-note on end-effectors used in robots. **06**

OR

7 a) Sketch and explain anatomy of a robot. **08**

b) Explain different types of Robotic sensor. **08**

c) Write a short-note on Robot Programming. **04**

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B.M.S. College of Engineering, Bengaluru-560019

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February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCDM2 / 16ME5DCDM2 **Max Marks: 100**
Course: Design of Machine Elements - 2

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.
3. Use of design data hand book is permitted.
4. Use of calculator is permitted.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) Determine an expression for extreme fibre stress of a curved beam subjected to pure bending moment with suitable assumptions. **10**

b) Determine the diameter *D* of a curved beam as shown in Figure 1b below. Assume yield stress of the beam material as 300 MPa and the factor of safety for the beam as 3. **10**

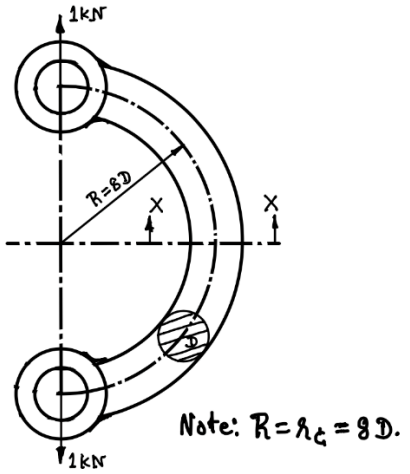

Figure 1b

OR

2 a) A railway wagon of weight 50 kN attains an initial velocity of 8 km/hr and is brought to rest by four buffer springs with its maximum allowable compression as 220 mm. Determine the shear stress and the number of turns associated with each helical spring of mean diameter 150 mm. The diameter of the spring wire is 25 mm, and the rigidity modulus of the spring is 84 GPa. Assume square and ground ends for each spring. **08**

b) Design a helical compression spring to withstand an axial load of 3000 N. The deflection under the load is limited to 60 mm. The spring index is 6. The spring is made of chrome-vanadium steel and the factor of safety is assumed as 2. **12**

UNIT - II

3 a) Derive an expression for the torque transmitting capacity of a single plate clutch from uniform wear theory. **08**

b) A band brake of a crane is actuated by a lever, the free end of which is pulled in the upward direction in order to apply the braking action. The lever length is 440 mm. The tight end of the band is attached to the fulcrum and the slack end to a pin, 50 mm from the fulcrum as shown in the Figure 3b below. The diameter of the brake drum is 1000 mm and that of the barrel is 650 mm. Determine the actuating force at the end of the brake lever in order to withstand a load of 20 kN. Assume coefficient of friction as 0.35 with angle of lap as 300^{o}. **12**

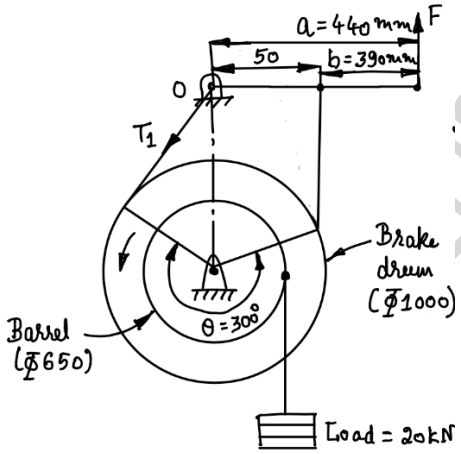

Figure 3b

UNIT - III

4 a) Develop an expression for the beam strength of a spur gear tooth with standard notations. **08**

b) A pair of carefully cut spur gears with 20^{o} full depth involute profile is used to transmit 12 kW of power. The speed of the pinion is 1200 rpm, while the gear has to rotate at 300 rpm. The material used for both pinion and gear is medium carbon steel with allowable bending stress of 230 MPa. Determine the module and face width of the spur pinion and the gear. The number of teeth on pinion is 24 and the service factor is 1.5 for the gears with medium shock condition, and consider 8-10 hours of duty per day. **12**

OR

5 a) Derive an expression for the beam strength of a helical gear tooth with a sketch. **08**

b) The following data refers to a worm and worm gear drive, (a) center distance is 200 mm, (b) pitch circle diameter of the worm is 80 mm, (c) number of start is 4, (d) axial module is 8 mm, (e) transmission ratio is 20, (f) the worm gear is made of phosphor bronze with an allowable bending stress of 55 MPa, (g) the worm is made of hardened and ground steel, (h) tooth form is 20 degrees full depth involute. Determine the following: (i) number of teeth on the worm gear, (ii) lead angle, (iii) face width of the worm gear to transmit 15 kW of power at 1750 rpm. **12**

UNIT - IV

6 a) Determine the power lost from a Petroff bearing with its journal length and diameter as 150 mm and 100 mm respectively. The speed of the journal is 1000 rpm, and the diametral clearance is 0.1 mm. The lubricating oil is SAE10 and the bearing operates at a temperature of 60^{o} C. **08**

b) Define the following bearing parameters: (i) Eccentricity(e), (ii) Short and long bearing, (iii) Diametral clearance ratio, (iv) Attitude, (v) Diametral clearance and (vi) Minimum oil film thickness. Write an appropriate expression for above parameters. **12**

UNIT - V

7 a) Determine the diameter of a wire rope used for a vertical mine hoist to lift a load of 10 kN from a depth of 600 m. The rope attains a maximum speed of 50 m/min with-in a time span of 2 seconds. The factor of safety is assumed as 7 for 6x19 type of rope. **12**

b) An electric motor with an average power of 2.5 kW attains an angular motion of 1200 rpm, and is used to drive a compressor shaft at a rated angular motion of 400 revolutions per minute. Select a suitable belt cross-section and determine (i) the diameter of two pulleys, (ii) tangential velocity of the belt and (iii) the power capacity N* of the belt drive. **08**

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February / March 2024 Semester End Main Examinations

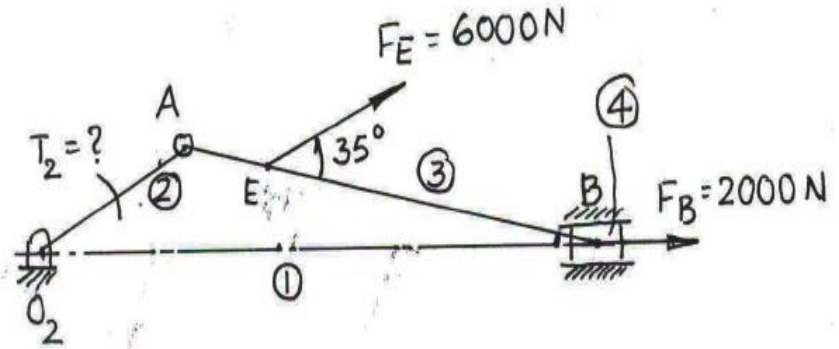
Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCDOM / 16ME5DCDOM **Max Marks: 100**
Course: Dynamics of Machines

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

UNIT - I

1 a) Explain how principle of virtual work is applied to determine the torque for a slider crank mechanism. **06**

b) For the mechanism shown in Fig(a), determine required input torque T2 on the crank for the static equilibrium of the mechanism. Given O2A =100mm, AB=250mm, AE=50mm and the crank has turned through 30°from the inner dead centre. **14**



Fig(a)

OR

2 a) Explain the function of a flywheel and Prove that the maximum fluctuation of energy in a flywheel as $\Delta E = 2E\,CS$. **06**

b) The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm to 500 N-m torque and 1 mm to 6° of crank displacement. The intercepted areas between output torque curve and mean resistance line taken in order from one end, in sq. mm are– 30, + 410, – 280, + 320, – 330, + 250, – 360, + 280, – 260 sq. mm,when the engine is running at 800 r.p.m. The engine has a stroke of 300 mm and the fluctuation of speed is not to exceed ± 2% of the mean speed. Determine a suitable diameter and cross-section of the flywheel rim for a limiting value of the safe centrifugal stress of 7 MPa. The material density may be assumed as 7200 kg/m 3 . The width of the rim is to be 5 times the thickness. **14**

UNIT - II

3 a) Derive an expression to find frictional torque for a Conical Pivot bearing considering uniform pressure theory. **06**

b) A leather belt is required to transmit 15kW from a pulley of 1200mm effective diameter running at 300rpm. The angle of contact is spread over 5/12 of circumference and coefficient of friction between belt and pulley rim is 0.3.If the safe working stress for the belt material is 1.5Mpa, density of leather is 1000 Kg/m^3 and thickness of belt is 10mm, determine the width of the belt taking centrifugal tension into account. **14**

OR

4 For a symmetrical tangent cam operating a roller follower, the least radius of cam is 30 mm and roller radius is 15 mm.The angle of ascent is 60˚,the total lift is 15 mm and the speed of the cam shaft is 300 rpm.Calculate **20**

i. Principal dimension of cam
ii. Acceleration and velocity of the follower at the beginning of the lift.
iii. Acceleration and velocity of the follower when the roller just touches the nose
iv. Acceleration and velocity of the follower when the roller contact is on the circular nose

UNIT - III

5 a) Explain the concepts of static balancing and dynamic balancing. **06**

b) A, B, C and D are four masses carried by a rotating shaft at radii 100,125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg, and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance **14**

UNIT - IV

6 a) Obtain an expression for primary forces for V-engine having two identical cylinders lying in a plane. The included angle between the cylinder centre lines is 90˚. **06**

b) A 5 Cylinder inline engine running at 500 rpm has successive cranks at 144˚apart.The distance between the cylinder centre lines is 300 mm. Piston stroke =240 mm, Length of connecting rod =480 mm. Examine the engine for balance of primary and secondary forces and couples. Find the maximum value of these and position of centre crank at which these maximum values occur. The reciprocating mass for each cylinder is 150 Kg. **14**

UNIT - V

7 a) Discuss the stability of a four-wheeler taking left turn. Axes of the engine and wheel axle are parallel and rotate in same sense. **10**

b) A ship propelled by a turbine rotor and has a mass of 5 tonnes and a speed of 2100 r.p.m. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. **10**

Find the gyroscopic effects in the following conditions:

i. The ship sails at a speed of 30 km/h and steers to the left in a curve having 60 m radius.
ii. The ship pitches 6 degree above and 6 degrees below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.
iii. The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.

Determine also the maximum angular acceleration during pitching. Explain how the direction of motion due to gyroscopic effect is determined in each case

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February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCMAE / 16ME5DCMAE **Max Marks: 100**
Course: Management and Entrepreneurship

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1	a)	Explain various modern management approaches with examples.	**10**
	b)	Discuss different planning premises by quoting examples.	**10**

OR

2	a)	Elaborate the various roles of a manager.	**05**
	b)	Discuss different types of decisions.	**05**
	c)	Discuss the steps in decision making.	**10**

UNIT - II

3	a)	Discuss the kinds of relationships and governing factors with respect to span of management.	**07**
	b)	Discuss Mechanistic V/s Organic organization structure.	**06**
	c)	Explain the various tests conducted during selection process.	**07**

UNIT - III

4	a)	Explain different leadership styles with appropriate examples.	**06**
	b)	Discuss the barriers for effective communication.	**06**
	c)	Explain the different techniques of coordination.	**08**

UNIT - IV

5	a)	Define Entrepreneur; Classify entrepreneurs by providing examples.	**10**
	b)	Discuss the role of entrepreneur in economic development of the nation.	**10**

UNIT - V

6	a)	Discuss the problems faced by SSI in India.	**08**
	b)	Discuss the role of the following institutions in promoting & supporting SSI i) DIC – single window ii) KIADB	**12**

OR

7	a)	Elaborate the steps involved in setting up a new business.	**10**
	b)	Explain the different types of registration of companies.	**10**

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February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCORE **Max Marks: 100**
Course: Operations Research

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.
3. Use of Statistical table permitted.

UNIT - I

1 a) Describe the characteristics of OR. **10**

b) A plant manufactures two products A and B. The profit contribution of each product is Rs 20 for A and Rs 24 for B. Each product passes through three departments of the plant. Time required and total time available is as follows. **10**

Departments	Hours required		Available hours During the month
	Product A	Product B	
1	2	3	1500
2	3	2	1500
3	1	1	600

The company has the contract to supply at least 250 units of product B per month. Formulate the LPP and solve by graphical method.

OR

2 a) Elaborate the phases of OR. **10**

b) Solve the following LPP by Penalty method. **10**

Max $Z = -2X_1-X_2$

S.T.

$3X_1+X_2+X_3 = 3$

$4X_1+3X_2 \geq 6$

$X_1+2X_2 \leq 4$

$X_1, X_2 \geq 0$

UNIT - II

3 a) Resolve the degeneracy in the following problem and solve it. **10**

Max $Z = 2X_1+X_2$

S.T.

$4X_1+3X_2 \leq 12$

$4X_1+X_2 \leq 8$

$4X_1-X_2 \leq 8$

$X_1, X_2 \geq 0$

b) Solve the following problem by dual simplex method. **10**

Min $Z = 2X_1+X_2$

S.T.

$3X_1+X_2 \geq 3$

$4X_1+3X_2 \geq 6$

$X_1+2X_2 \geq 3$

$X_1, X_2 \geq 0$

UNIT - III

4 a) Solve the following transportation problem by lowest cost entry method and further determine the optimality test. **10**

	D1	D2	D3	Supply
S1	50	30	220	1
S2	90	45	170	3
S3	250	200	50	4
Demand	4	2	2	

b) Solve the travelling sales man job. **10**

	1	2	3	4	5
1	----	10	25	25	10
2	1	------	10	15	2
3	8	9	-----	20	10
4	14	10	24	-----	15
5	10	8	25	27	-------

OR

5 a) Solve the following transportation problem. **10**

	F1	F2	F3	F4	F5	Requirement
S1	4	2	3	2	6	8
S2	5	4	5	2	1	12
S3	6	5	4	7	3	14
Demand	4	4	6	8	8	

b) A company has 4 salesmen A,B,C,&D. These salesmen are to be allotted 4 cities1,2,3&4. The estimated profit per day for each salesmen in each city is given in the following table. What is the optimum assignment which will yield maximum profit. **10**

	1	2	3	4
A	16	10	14	11
B	14	11	15	15
C	15	15	13	12
D	13	12	14	15

UNIT - IV

6 a) Solve the following game graphically. **10**

	B1	B2	B3	B4
A1	2	2	3	-1
A2	4	3	2	6

b) Use the graphical method to minimize the following jobs on 5 machines shown. For each machine find the job which should be done first. Also calculate the total time needed to complete both the jobs. **10**

Job 1	Sequence	A	B	C	D	E
	Time (hrs)	2	3	5	2	1
Job 2	Sequence	D	C	A	B	E
	Time (hrs)	6	2	3	1	3

UNIT - V

7 a) The cost of the machine is Rs 6100/- and its crap value is only Rs 100/- the maintenance costs are found from the experience are as follows. **10**

Year	1	2	3	4	5	6	7	8
Maint. Cost (Rs.)	100	250	400	600	900	1250	1600	2000

When should the machines be replaced?

b) A computer contains 10, 000/- resistors. When any one of the resistor fails, it is replaced. The cost of replacing a single resistor is Rs. 10/- only. If all the resistors are replaced at the same time, the cost per resistor would be reduced to Rs. 3.50/-. The percent surviving by the end of month 't' is as follows: **10**

Month (t)	0	1	2	3	4	5	6
% surviving by the end of month	100	97	90	70	30	15	0

What is the optimum plan?

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February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DCTUM / 16ME6DCTUM **Max Marks: 100**
Course: Turbo Machines

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.
3. Use of steam tables is permitted.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) C1 Batch students performed experiment on Pelton wheel at Turbo lab. They obtained head as 1.8 m and power as 0.1 kW. The speed of the turbine is found to be 500 RPM. The diameter is 0.35 m. The concerned Faculty asked them to find out the speed and diameter of the turbine that develops 1500 kW at 250 m. Solve this problem by using appropriate formula. **05**

b) Identify the blade profile of Axial flow Turbomachine which is given below in the Figure. Give reason for choosing your answer. Also draw velocity triangles for inlet and outlet for this Turbomachine. **05**

c) Derive an expression for Euler turbine equation and obtain its alternative form. **10**

UNIT - II

2 a) A Centrifugal compressor with the radial exit condition has an impeller diameter of 45 cm and running at 4200 RPM. Determine the outlet linear blade velocity and pressure ratio attained. **10**
For the same Pressure ratio, speed and impeller diameter. If the outlet blade angle is 32°, then determine the flow velocity and whirl velocity at outlet. What modification is to be done for the pressure ratio equation?
Consider the stagnation temperature at inlet of the compressor as 303 K, isentropic efficiency as 90%, neglect slip factor and Power input factor for both cases.

b) Derive an expression for Radial Equilibrium Theory in Axial flow compressors. What is the significance of Radial equilibrium theory? **10**

OR

3	a)	What is the advantage and disadvantage of using backward type of blade design in centrifugal compressor?	**02**
	b)	Contrast between Centrifugal and Axial flow compressor in terms of discharge, pressure ratio and exit velocity triangles.	**04**
	c)	Explain the phenomenon of Surging and Chocking in Centrifugal compressor with help of neat graph.	**05**
	d)	Following are the conditions for axial flow compressor at a diameter of 0.25 m: Fluid inlet angle is 25° Blade angle at inlet is 35° Degree of reaction is 50%. Inlet absolute velocity is 140 m/s and is considered to be constant from hub to tip due to inviscid condition. Axial component is constant from inlet to outlet. Speed of the compressor is 15000 RPM. Determine the whirl velocity at inlet and outlet of the blade.	**09**

UNIT - III

4	a)	Give reasons: i. What happens when the Euler head is greater than the Manometric head? ii. What should be the value of Maximum suction lift if you consider there is no losses due to hydraulic friction?	**02**
	b)	With the help of line diagram of the centrifugal pump and explain the pressure heads, Manometric head and Manometric efficiency.	**07**
	c)	A Centrifugal pump has the following data: Speed is 2000 RPM, Blade angle is bent forward with 120° to the blade tangent, width of the blade at outlet is 0.1 times the impeller diameter, discharge is 0.05 m^3/s, Vertical height is 40 m. Suction and delivery pipes are 150 mm each. The pump casing is fitted with pipe with length of 5 m at suction side and 45 m at delivery side. The friction factor of the pipe is 0.005. Blades occupy 5% of the circumferential area and manometric efficiency is 75%. Determine the impeller diameter of the pump.	**11**

UNIT - IV

5	a)	Explain Pressure compounding and Velocity compounding in steam turbines with the help of neat sketches.	**10**
	b)	Inlet velocity of a steam in a steam turbine is 150 m/s, ratio of flow velocity to linear blade speed at inlet and outlet are 0.75 and 0.78 respectively. Discharge blade angles of stator and rotor are 20°. Mass flow rate of steam is 2.5 kg/s. Construct the inlet and outlet velocity triangles by graphical method. Also determine the Work done, Power and Degree of reaction.	**10**

UNIT - V

6	a)	What is the purpose of providing notches in the bucket in Pelton wheel? Derive an expression for maximum efficiency in Pelton wheel.	**10**

b) A Conical Draft tube has the following data: **10**
Inlet diameter is 1.4 m, Outlet diameter is 1.8 m, Velocity of water at outlet is 3 m/s, Total height of the draft tube is 7m, Height of draft tube immersed in water at outlet is 1.5 m and Frictional losses is 30% of the velocity head at the outlet. Calculate the Pressure head at the inlet of the draft tube and also its efficiency.

OR

7 a) Contrast between Francis and Kaplan turbine in terms of head, type of flow and Specific speed. **03**

b) A Student from A4 Batch was asked to show a Draft tube of a Pelton wheel during Turbo lab test. What would be the right answer for this? Comment on this. What is the purpose of Draft tube? With help of sketches explain conical and elbow draft tube. **07**

c) B5 batch students visted a Power station where they saw a Francis Turbine. It has a runner of outer diameter of 0.5 m with the width of 7.5 cm. Inner diameter is 0.35 m. The effective flow area is 93% of the gross area and flow velocity is constant throughout. The guide vane angle is 23°, inlet vane angle is 97° and outlet vane angle is 30°. Consider hydraulic friction loss as 10% and Mechanical Efficiency as 94%. If the Head available was 15m, 60m and 300m. Choose the head that suits the Francis turbine, with justification to determine the Power developed by the turbine, Speed of the runner and the Specific speed of the turbine. **10**

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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DEBHM **Max Marks: 100**
Course: Biomechanics of Human Movement

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

UNIT - I

1 a) Define Cost of Transport and discuss the relationship between CoT and walking speed with a neat diagram. **06**

b) Race walkers achieve high walking speeds by altering their gait kinematics. In 2015, Yusuke Suzuki of Japan set the world record for the men's 20-km racewalk with a time of 1:16:36. What was Yusuke's average speed in m/s and his Froude number at this speed, assuming his leg length is 0.9 m? Why is it possible for him to "walk" with a Froude number greater than 1? **06**

c) With neat diagrams show the sagittal plane joint motions in the elbow, hip, knee and ankle joints. **08**

UNIT - II

2 a) List and define the five muscle specific model parameters. **10**

b) The following equation can be used to calculate muscle fiber force (F^M) at an activation (a), fiber length (l), and fiber velocity (v): **10**

$$F^M = F_0^M[a \cdot f^l(l) \cdot f^v(v) + f^{pe}(l)]$$

The functions $f^l(l), f^v(v)$ and $f^{pe}(l)$ represent the normalized active force–length, force–velocity, and passive force–length curves, respectively; and F_0^M represents the maximum isometric muscle force. How does this equation simplify in each of the following cases?

Muscles fibers are:

(i) isometric
(ii) at optimal fiber length
(iii) maximally activated
(iv) inactive
(v) 50% activated

OR

3 a) State the principle of virtual work and using this derive an expression for muscle moment arm based on tendon excursion definition. **10**

b) Using the expression derived in 4A, show how muscle moment arm affects muscle lengths and velocities and hence the force generating capacity of a muscle with neat sketches. **10**

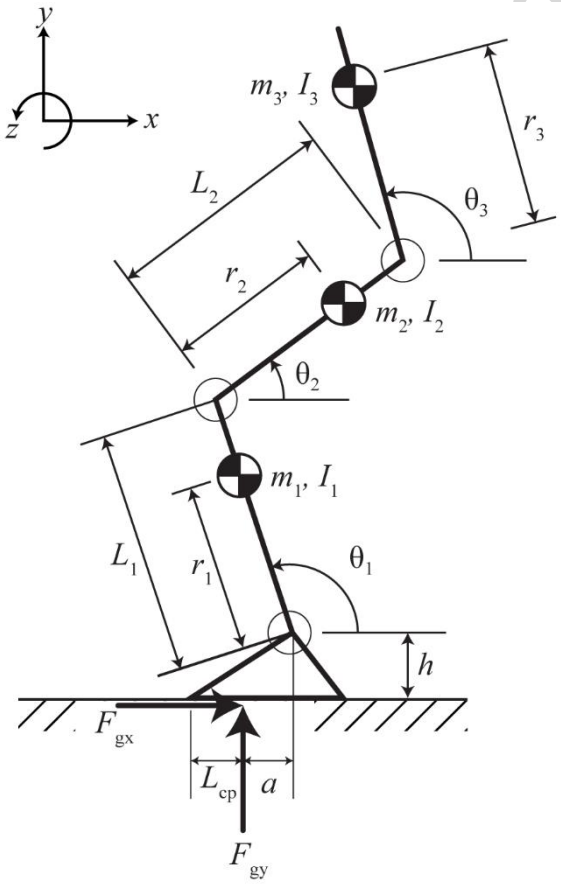
UNIT - III

4 a) Derive the equivalent rotation matrix for XYZ body fixed euler-angle sequence. **10**

b) Discuss the constrained inverse kinematics work flow and mention its advantages. **10**

UNIT - IV

5 Consider the planar human model shown in figure below. Please derive complete analytical expressions for the net joint torques exerted at the ankle (T_1), knee (T_2), and hip (T_3) during sit-to-stand motion. Assume that the foot remains flat on the floor. **20**



OR

6 a) Discuss the generic optimization problem formulation. **10**

b) Discuss the predictive simulation workflow with a flow chart. **10**

UNIT - V

7 a) Discuss the need for muscle driven simulations with examples. **06**

b) Discuss briefly one case study illustrating the application of musculoskeletal modelling. **06**

c) Discuss the muscle driven forward dynamic simulation workflow with a neat block diagram. **08**

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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DEICE **Max Marks: 100**
Course: Internal Combustion Engines

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1	a)	Explain the various simplified assumptions used in fuel-air cycle analysis.	**06**
	b)	Explain with the help of a p-V diagram the loss due to variation of specific heats and effect of dissociation in an Otto cycle.	**08**
	c)	What will be the effect on the efficiency of an Otto cycle having a compression ratio of 8, if Cv increases by 1.6%?	**06**

UNIT - II

2	a)	What are different air-fuel mixture on which an engine can be operated?	**06**
	b)	Explain electronic fuel injection system.	**08**
	c)	Draw a schematic diagram of fuel feed pump and explain its working principle.	**06**

UNIT - III

3	a)	Briefly explain the stages of combustion in SI engines elaborating the flame front propagation.	**06**
	b)	Explain the various factors that influence the flame speed.	**08**
	c)	Bring out clearly the process of ignition delay illustrating Pressure-time diagram for CI engine	**06**

UNIT - IV

4	a)	What are the various types of combustion chambers used in SI engines? Explain any two types with neat sketch..	**06**
	b)	List out various combustion chambers used in CI engines and explain with neat sketch Air-cell combustion chamber.	**08**
	c)	Explain with a figure the variation of gas temperature during a cycle.	**06**

OR

5	a)	Give the general chemical formula of the following fuels: (i) Paraffin (ii) Olefin (iii) Diolefin (iv) Naphthene (v) Aromatic. Also state their molecular arrangements and mention whether they are saturated or unsaturated.	**10**
	b)	Explain alcohols as alternate fuels for IC engines bringing out their merits and demerits.	**10**

UNIT - V

6	a)	Explain with graph emissions as a function of equivalence ratio for a SI and CI engine	**10**
	b)	Compare Bharat stage 4 and Bharat stage 6 emission norms of IC engine.	**10**

OR

7	a)	Discuss suitability and the salient characteristics of multi fuel engine	**08**
	b)	Discuss briefly the following engines: i) Rotary piston engines, ii) Stratified engine and iii) Multiple injection system.	**12**

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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DENTM **Max Marks: 100**
Course: Non-Traditional Machining

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1	a)	Classify and briefly explain non-traditional machining process.	**10**
	b)	Explain the mechanism of metal removal in USM process with neat sketch.	**10**

UNIT - II

2	a)	Describe the mechanism of metal removal in AJM with neat sketch.	**10**
	b)	Explain the elements of AWJM.	**10**

UNIT - III

3	a)	Explain the ECM elements with neat sketch.	**10**
	b)	List out the merits and demerits of chemical milling.	**10**

OR

4	a)	Using a rotating tool, describe the electrochemical deburring.	**10**
	b)	Elaborate the maskants and etchants in chemical machining process.	**10**

UNIT - IV

5	a)	With neat sketch describe the EDM process.	**10**
	b)	Describe the mechanism of metal removal in LBM with neat sketch.	**10**

OR

6	a)	Describe the parameters affecting the performance of EDM.	**10**
	b)	List the merits and applications s of PAM process.	**10**

UNIT - V

7	a)	Describe the mechanism of material removal in EBM process.	**10**
	b)	With neat sketch describe the LOM process.	**10**

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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME5DERES **Max Marks: 100**
Course: Renewable Energy Sources

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1	a)	What is Clean Development Mechanism (CDM)? List and explain the various steps of CDM.	**10**
	b)	Explain the various aspects of energy conservation.	**05**
	c)	What does Energy Conservation and energy Audit mean?	**05**

UNIT - II

2	a)	Explain I-V and P-V characteristics of a solar cell with relevant sketches.	**10**
	b)	Explain construction of PV array using solar cells.	**05**
	c)	Sketch and explain construction of solar flat plate collector	**05**

UNIT - III

3	a)	Draw a neat labelled vector diagram of the forces acting on an elemental blade section of an aero-turbine and list all the notations used.	**10**
	b)	What are the environmental aspects of using wind energy?	**05**
	c)	How do yaw control and pitch control work in wind turbines? Which axis wind turbine does not need yaw control?	**05**

OR

4	a)	Explain with sketch Darrieus type vertical axis wind mill.	**10**
	b)	Plot Power generation v/s Wind speed curve and explain all the regions.	**05**
	c)	What is the necessity of speed control of wind turbine, list any four control strategies.	**05**

UNIT - IV

5	a)	Explain the down draught gasifier with neat sketch showing various temperature regions and the sequence of reactions.	**10**
	b)	Explain the factors on which efficiency of biogas generation depends upon.	**10**

OR

6	a)	Explain the design, construction and operation of fluidized bed gasifier.	**10**
	b)	Explain the process of Ethonol production from sugarcane using block diagram.	**10**

UNIT - V

7	a)	Explain the V-I characteristics and polarization with respect to fuel cells.	**10**
	b)	With neat sketches and relevant reactions, explain the following type of Fuel Cells i) Phosphoric Acid Fuel Cell (PAFC) ii) Solid Oxide Fuel Cell (SOFC)	**10**

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B.M.S. College of Engineering, Bengaluru-560019

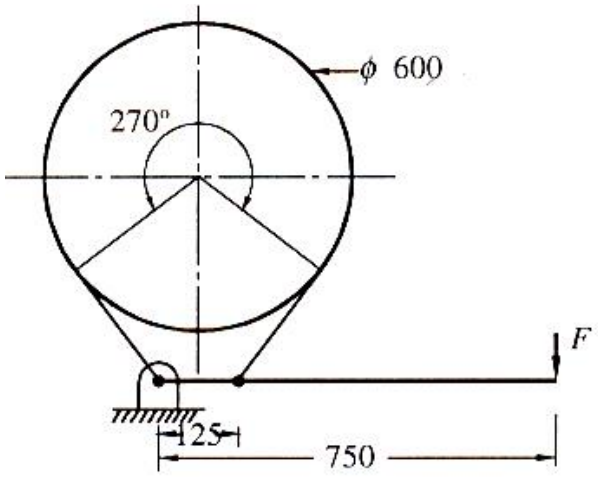
Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PCDM2 **Max Marks: 100**
Course: Design of Machine Elements - 2

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Machine Data Handbook is permitted.

		UNIT - I	CO	PO	Marks
1	a)	State two major differences between straight beam and curved beam. What are the assumptions made in finding stress distribution for curved flexural member? Also derive an expression for normal stresses due to bending at extreme fibers on the cross section of curved beam.	CO1	PO1	**10**
	b)	A crane hook of rectangular cross section 30 wide, 60mm deep has an inner radius of curvature 90 mm. The load line is 80 mm from inside of the section. Determine the maximum fibre stresses induced if it carries a load of 30 kN.	CO1	PO2	**10**
		OR			
2	a)	Design a spring for an elevator shaft at the bottom of which 8 identical springs are set in parallel to absorb the shock of the elevator in case of failure. The weight of elevator is 60 KN and the counter weight of elevator is 20 KN. The elevator has a free fall of 1.5 meters from rest. The spring is made of 25 mm diameter rod. Determine the maximum stress in each spring, if the spring index is 6. Each spring has 15 active turns. Take G = 84Gpa.	CO1	PO3	**10**
	b)	A multi leaf spring with camber is fitted to the chassis of an automobile over a span of 1.2m to absorb shocks due to a maximum load of 20kN. The spring material can sustain a maximum stress of 0.4GPa. All the leaves of the spring were to receive the same stress. The spring is required at least 2 full length leaves out of 8 leaves. The leaves are assembled with bolts over a span of 150 mm width at the middle. Design the spring for a maximum deflection of 50mm. Take E=208 GPa.	CO1	PO3	**10**

			UNIT - II			
	3	a)	A simple band brake (Figure 1) operates on a drum 600 mm in diameter rotating at 200 rpm. The coefficient of friction is 0.25 and the angle of contact of the band is 270°. One end of the band is fastened to a fixed pin and the other end to 125 mm from the fixed pin. The brake arm is 750 mm long. i) What is the minimum pull necessary at the end of the brake arm to stop the wheel if 15 kW is being absorbed? What is the direction of rotation for minimum pull? ii) Find the width of 2.5 mm thick steel band if the maximum tensile stress is not to exceed 56 N/mm^2. iii) Design the lever (Take allowable stress for the lever material σ_0= 110 MPa and assume rectangular cross section, h=3b)  Figure 1	*CO2*	*PO3*	**10**
		b)	A Multiple plate clutch has steel on bronze is to transmit 8 KW at 1440 rpm. The inner diameter of the contact is 80mm and outer diameter of contact is 140 mm. The clutch operates in oil with coefficient of friction of 0.1. The overage allowable pressure is 0.35Mpa. Assume uniform wear theory and determine the following: i) Number of steel and bronze plates ii) Axial force required iii) Actual maximum pressure	*CO2*	*PO2*	**10**
			UNIT - III			
	4	a)	Derive an expression for beam strength of a spur gear tooth with standard notations.	*CO3*	*PO1*	**04**
		b)	A cast steel spur gear pinion (σ_0= 138.3 MPa) having 21 teeth and rotating at 1500 rpm is required to transmit 9 kW to a high grade Cast Iron gear (σ_0= 78.5 MPa) to run 500 rpm. The teeth are 20^0 Full Depth Involute (FDI) form. Design gears completely. Take service factor C_s = 1.5 and face width=10m)	*CO3*	*PO3*	**16**
			OR			

	5	a)	Demonstrate the formative number of teeth of bevel gears.	*CO3*	*PO1*	**04**
		b)	A pair of bevel gears to transmit 15 kW at 1250 rpm of 120 mm diameter case hardened steel pinion(σ_0= 343.34 MPa) to a 0.2%C heat treated cast steel gear (σ_0= 191.295 MPa) at a speed ratio of 3.5. Use 20^0 FDI tooth system. The angle between the shaft axes is 90^0. Take service factor as 1.25. Design the gears and suggest the suitable hardness for the gears. (Take face width, b= L/3 or R/3).	*CO3*	*PO3*	**16**
			UNIT - IV			
	6	a)	Derive Petroff's equation for lightly loaded journal bearing and explain the bearing modulus.	*CO4*	*PO1*	**08**
		b)	A full journal bearing of diameter 50mm and 100 mm long has a bearing pressure of 1.4 MPa. The speed of the journal is 900 rpm and the ratio of journal diameter to the diametrical clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75^0C may be taken as 0.011 kg/m-s. The room temperature is 35^0C. Determine the following. i) The amount of artificial cooling required. ii) The mass of lubricating oil is required; if the difference between the outlet and the inlet temperature of the oil is 10^0C, take specific heat of oil as 1850J/kg^{0}C.	*CO4*	*PO3*	**12**
			UNIT - V			
	7	a)	Select a V-belt drive to connect a 15kW, 2880 rpm motor to a centrifugal pump, running at approximately 2400 rpm, for a service of 18 hrs per day. The center distance should be approximately 400mm. Assume the pitch diameter of driving pulley as 125mm. determine the number of V belts required using **B** type of belt**.** (Take service factor for the driven member=1.2)	*CO5*	*PO3*	**12**
		b)	A 8 x 19 steel wire rope is to hoist 50kN of load from a depth of 1000m. Determine the number of ropes required if the maximum speed of 2.5m/s and acceleration is 1.25m/sec^2, assuming the rope is made of 25 mm diameter. Neglect the weight of the tackle. Take F_U=235.362 kN.	*CO5*	*PO3*	**08**

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B. M. S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PCMAE **Max Marks: 100**
Course: Management and Entrepreneurship

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT – I	CO	PO	Marks
1	a)	Explain briefly the functions of management.	CO1	PO1	**08**
	b)	Distinguish between management and administration. comment on the nature of management, is it a science or art?	CO1	PO1	**06**
	c)	Discuss in detail roles of Manager.	CO1	PO1	**06**
		OR			
2	a)	Differentiate between: i. Strategic planning and tactical planning ii. Single use plan and standing plans	CO1	PO1	**08**
	b)	Explain planning premises.	CO1	PO1	**06**
	c)	What are the importance of planning, discuss.	CO1	PO1	**06**
		UNIT – II			
3	a)	Briefly explain the any four principle of organization.	CO2	PO1	**08**
	b)	Explain the types of decisions.	CO2	PO1	**08**
	c)	Discuss importance of staffing.	CO2	PO1	**04**
		UNIT - III			
4	a)	What are the important characteristics of leadership.	CO3	PO1	**04**
	b)	Explain Maslow's need hierarchy theory of Motivation along with its Merits and Demerits.	CO3	PO1	**10**
	c)	Explain the steps involved in controlling.	CO3	PO1	**06**
		UNIT - IV			
5	a)	Define Entrepreneur? Explain the Characteristics of Entrepreneur.	CO4	PO1	**10**
	b)	Explain the important role that an entrepreneur plays in the economic development of a country.	CO4	PO1	**04**

		c)	What are the barriers of Entrepreneur?	*CO4*	*PO1*	**06**
			OR			
	6	a)	What are objectives and functions of KIADB.	*CO5*	*PO1*	**08**
		b)	Define SSI? Explain the roles of SSI in Economic Development?	*CO5*	*PO1*	**06**
		c)	What are objectives and functions of SIDBI?	*CO5*	*PO1*	**06**
			UNIT – V			
	7	a)	Explain various factors to be considered for selection of a project.	*CO6*	*PO1*	**08**
		b)	Explain ERP and mention its importance.	*CO6*	*PO1*	**08**
		c)	Explain the phases of project identification with its sources.	*CO6*	*PO1*	**04**

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B.M.S. College of Engineering, Bengaluru-560019

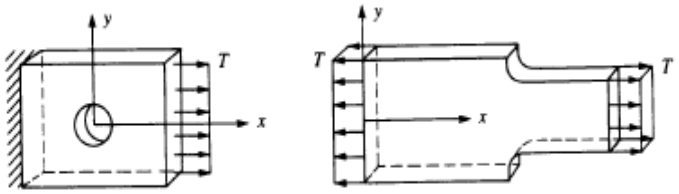
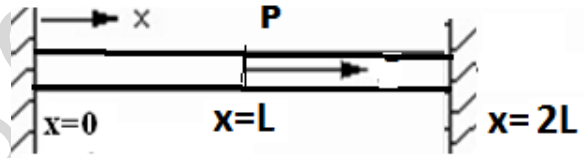
Autonomous Institute Affiliated to VTU

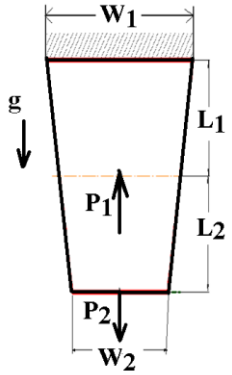
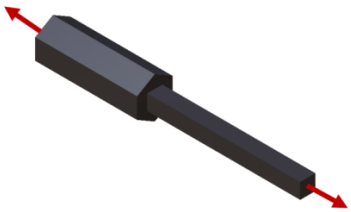
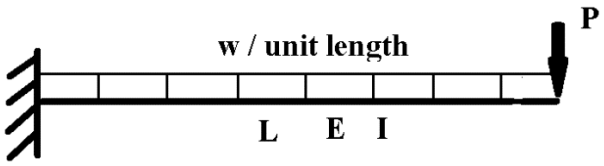
February / March 2024 Semester End Main Examinations

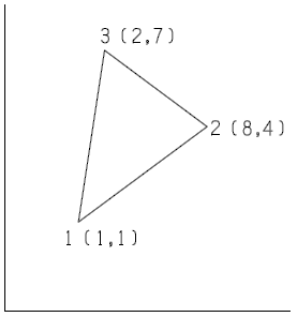
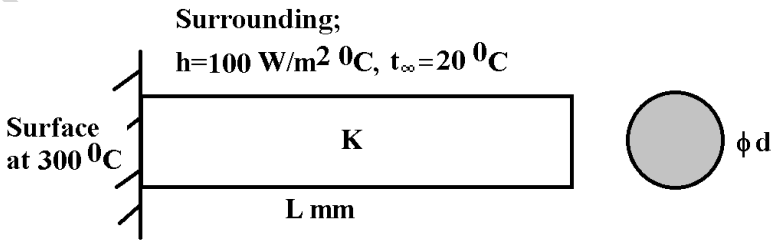
Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PCMFE **Max Marks: 100**
Course: Modelling and Finite Element Analysis

Instructions: 1.Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Identify the idealization of 2D problems shown in Figure 1a. State the geometric and corresponding stress/strain conditions and write stiffness matrices.  Figure 1a	C01	P01	**06**
	b)	Using Rayleigh Ritz method obtain expressions for displacement and stress for uniform bar shown in Figure 1b. Normalize the values if P=A=L=E=1  Figure 1b	C01	P01	**10**
	c)	Explain, with examples of bar, essential and non essential boundary conditions	C01	P01	**04**
		OR			
2	a)	Find the expression for the displacement of a cantilever beam subjected to UDL q_0 acting along its length using the Galerkin method.	C01	P01	**10**
	b)	Explain with an example of a beam ,essential and Non-essential boundary conditions	C01	P01	**04**
	c)	Evaluate I = $\int_{-1}^{1}(3e^x + x^2 + \frac{1}{(x+2)})dx$ using one-point and two-point Gauss Quadrature.	C01	P01	**06**

			UNIT - II			
	3	a)	For the problem shown in Figure 3(a). ; Determine the nodal displacements, element stresses and reactions. Thickness of the plate=5 mm, W_1=50 mm, W_2=30 mm. Density=8000 kg/m^3 and E=100GPa.Where L_1=1.5m, L_2=1.5m, P_1=70kN, P_2=70kN.	*C03*	*P01*	**14**
			 Figure 3(a)	 Figure3.(b)		
		b)	Recommend the type of element that is used to solve the stepped bar problem shown in Figure 3(b). Derive the shape functions of the element recommended.	*C02*	*P02*	**06**
			UNIT - III			
	4	a)	Derive the Hermite shape functions for a 2-noded beam element with 2 DOFs at each node.	*C02*	*P02*	**06**
		b)	For the problem shown in Figure 4b, determine the nodal unknowns and reactions. E =200 GPa, I=10x10^{-4} m^4, L=3m, w=10N/m, P=50kN.  Figure 4b	*C03*	*P01*	**14**
			UNIT - IV			
	5	a)	Identify and justify whether 2D plane stress elements or 2D plane strain elements can be used for modeling the effects of water pressure on a dam. Write the [D] matrix.	*C01*	*P01*	**04**
		b)	Write shape functions for CST element and derive strain displacement matrix under plane stress condition.	*C02*	*P02*	**08**

		c)	For the triangular element shown in figure 5c, determine the strain ε_x, ε_y and γ_{xy}. Given, displacements $q_1 = 0.001, q_2 = -0.004$, $q_3 = 0.003$, $q_4 = 0.002$, $q_5 = -0.002$ and $q_6 = 0.005$.mm  Fig.5c	*C03*	*P01*	**08**
			OR			
	6	a)	Using the Lagrange interpolation function, formulate the shape functions for the 9-noded quadrilateral element.	*C02*	*P02*	**08**
		b)	Explain convergence criteria and compatibility requirements for finite element solution.	*C02*	*P02*	**05**
		c)	Evaluate strain displacement matrix at the centroid of 3-noded axisymmetric element having nodal coordinates (r, z); (50, 0), (70, 0) and (70, 20).	*C03*	*P01*	**07**
			UNIT - V			
	7	a)	Explain the types of boundary conditions in heat transfer problems.	*C02*	*P02*	**06**
		b)	Determine the temperature distribution and amount of heat transfer in a rectangular fin shown in Figure 7b. Use two 2-noded 1-D heat transfer elements. Also obtain the temperature at mid-point of the 1st element. Assume that the end face of the fin is insulated. L=0.05 m, d=0.01 m and K =50 W/m^{0}C.  Figure 7b	*C03*	*P03*	**14**

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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PCMMM **Max Marks: 100**
Course: Mechanical Measurements and Metrology

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Describe wave length standard with its advantages.	CO1	PO1	**04**
	b)	A calibrated meter end bar has an actual length of 1000.0003mm.It is to be used in the calibrated of two bars A&B, each having a basic length of 500mm. when compared with the meter bar L_A+L_B was found to be shorter by 0.0002mm. In comparing A with B it was found that A was 0.0004mm longer than B. Find the actual length of A & B.	CO1	PO1	**06**
	c)	Describe with neat sketch i) Imperial standard yard ii) International Prototype meter.	CO1	PO1	**10**
		OR			
2	a)	Draw the conventional diagram of Limits and Fits. Explain the terms; i) Basic size ii) Upper deviation iii) Lower deviation iv) Fundamental deviation v) Zero line.	CO2	PO2	**10**
	b)	Describe briefly the system of obtaining different types of fits, with suitable sketches.	CO2	PO2	**10**
		UNIT - II			
3	a)	How the plain gauges are classified.	CO2	PO1	**04**
	b)	Explain with neat sketch the working of the Reed Type mechanical comparator.	CO2	PO1	**06**
	c)	Select the sizes of angle gauges required to build the following angles; Show the arrangement of gauges. i) 33^0 16' 42" ii) 57^0 34' 9".	CO3	PO1	**10**
		UNIT – III			
4	a)	With a block diagram, explain three stages of generalized measurement system giving suitable examples.	CO3	PO1	**10**
	b)	With a neat sketch explain the construction of a Cathode Ray Oscilloscope.	CO4	PO1	**10**

			UNIT - IV			
	5	a)	With the help of neat diagram, explain the working of an analytical balance.	*CO4*	*PO1*	**10**
		b)	Explain with a neat sketch, the Absorption Dynamometer- Prony brake dynamometer of Torque measurement.	*CO4*	*PO1*	**10**
			OR			
	6	a)	Explain the working of a Mechanical strain gauge (Berry) extensometer with neat sketch.	*CO4*	*PO2*	**10**
		b)	With a block diagram show the Arrangement of a resistance bridge for strain measurement. Explain in detail.	*CO4*	*PO1*	**10**
			UNIT - V			
	7	a)	With the help of block diagram of Coordinate Measuring machine, describe the different basic configuration.	*CO4*	*PO2*	**10**
		b)	Explain the importance of Nanometrology.	*CO4*	*PO1*	**04**
		c)	Draw neat diagram of Scanning Electron Machine (SEM) and label all the parts on it.	*CO4*	*PO1*	**06**

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B.M.S. College of Engineering, Bengaluru-560019

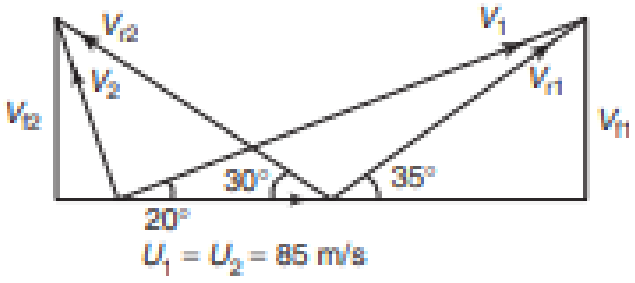
Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PCTFE **Max Marks: 100**
Course: Thermal and Fluid Engineering

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Define the turbomachine and with necessary assumptions derive the Euler equation.	*CO1*	*PO1*	**10**
	b)	The velocity triangles at the inlet and outlet are given in Fig. (1). State with reasons the following: (i) Whether the machine is radial flow type or axial flow type; (ii) Whether the machine is work-producing type or work-absorbing type; (iii) Specific work W; (iv) Power per unit flow rate; and (v) Utilization factor. Assume Vr_2=0.98 Vr_1  Fig. (1)	*CO1*	*PO2*	**10**
		OR			
2	a)	With the help of velocity triangles obtain the maximum work done and maximum hydraulic efficiency expressions for a Pelton wheel.	*CO1*	*PO1*	**10**
	b)	A Francis turbine is to be designed for the flow rate of 2 m^3/s available at a project site at a net head of 10 m of water. The expected overall efficiency is 80%. The speed coefficient (or speed ratio) and the flow coefficient can be assumed as 0.8 and 0.6, respectively. The hydraulic losses in the turbine are 15% of available energy. Design the turbine rotor, with the salient dimensions and angles, to run at 300 rpm. The water leaves the rotor without any whirl component.	*CO1*	*PO2*	**10**

			UNIT - II			
	3	a)	Define the following terms related to centrifugal compressor: i) Work done factor; ii) Slip; iii) Choking; iv) Surging; and v) Pre-whirl	*CO2*	*PO1*	**10**
		b)	The diameter ratio of the impeller of a centrifugal compressor is 2 and the pressure ratio is 4, the speed is 12000 rpm, the flow rate is 10 m^3/s of free air. The isentropic efficiency of the compressor is 84%. The blades are radial at the outlet and the entry is radial at the inlet. The velocity of flow remains constant at 60 m/s through the impeller. Calculate, (i) power input to the machine, (ii) the impeller diameters at the inlet and outlet, and iii) the blade angle at the inlet. The suction is from the atmosphere at 100 k Pa and 300 K.	*CO2*	*PO2*	**10**
			UNIT - III			
	4	a)	Draw the inlet and exit velocity triangles for the centrifugal pump with all notations.	*CO2*	*PO1*	**02**
		b)	Define manometric efficiency, MSL and NPSH. Write the necessary equations for manometric efficiency, MSL and NPSH used in analysis of centrifugal pump.	*CO2*	*PO1*	**09**
		c)	The power input to a centrifugal pump is 50 kW at the shaft while running the pump at 1440 rpm. The impeller tip diameter is 30 cm and the blade width at the tip is 1.5 cm. The water flow rate is 110 liter/s (0.11 m^3/s). The vacuum gauge reading at the suction flange is –20 cm of mercury and at delivery flange; the pressure gauge reading is 370 kPa. The blade outlet angle is 65^0. A 2% slip may be assumed. Calculate the (i) theoretical head, (ii) ideal head, (iii) hydraulic efficiency, (iv) mechanical efficiency, (v) overall efficiency, and (vi) specific speed of the pump. Assume radial entry and constant flow velocity.	*CO2*	*PO2*	**09**
			UNIT - IV			
	5	a)	Prove the statement on the quality of energy, 'The available exergy of a fluid at a higher temperature is more than at a lower temperature and decreases as the temperature decreases.'	*CO3*	*PO1*	**08**
		b)	Write the expression for exergy balance equation for the closed system with all the abbreviations.	*CO3*	*PO1*	**02**
		c)	Air expands through a turbine from 500 kPa, 520 ^{0}C to 100 kPa 30^0C. During the expansion, 10 kJ/kg of heat is lost to the surroundings which is at 98 kPa, 20^0C. Neglecting the K.E. and P.E. changes. Determine per kg of air i) the decrease in availability, ii) the maximum work, and iii) the irreversibility. For air, C_p = 1.005 kJ/kg K, $h = c_p T$.	*CO3*	*PO1*	**10**
			UNIT - V			
	6	a)	Draw the P-V and T-S diagram for dual combustion cycle	*CO4*	*PO1*	**02**
		b)	Show that the thermal efficiency of Otto cycle is,	*CO4*	*PO1*	**10**

			$\eta_{th,\,Otto} = 1 - \frac{1}{r^{k-1}}$ where r- compression ratio; k= ratio of specific heats			
		c)	In a gas turbine plant working on Brayton cycle, the air at inlet is 27°C, 0.1 MPa. The pressure ratio is 6.25 and the maximum temperature is 800°C. The turbine and compressor efficiencies are each 80%. Find compressor work, turbine work, heat supplied, cycle efficiency and turbine exhaust temperature. Mass of air may be considered as 1 kg.	*CO4*	*PO1*	**08**
			OR			
	7	a)	Discuss the combustion stages in C.I Engines with the help of p-θ diagram.	*CO4*	*PO1*	**08**
		b)	List any 2 salient features of detonation in SI engines.	*CO4*	*PO1*	**02**
		c)	In a test of an oil engine under full load condition, the following results were obtained. IP = 33 kW; Brake power = 27 kW; Fuel used = 8 kg/h; Rate of flow of water through gas calorimeter = 12 kg/min; Cooling water flow rate = 7 kg/min; Calorific value of fuel = 43 MJ/kg; Inlet temperature of cooling water = 15^0C; Outlet temperature of cooling water = 75^0C; Inlet temperature of water to exhaust = 15^0C; gas calorimeter Outlet temperature of water to exhaust = 55^0C; gas calorimeter final temperature of the exhaust gases = 80^0C; Room temperature = 17^0C; Air-fuel ratio on mass basis = 20, Mean specific heat of exhaust gas = 1 kJ/kg K; Specific heat of water = 4.18 J/kg K. Draw up a heat balance sheet and estimate the thermal and mechanical efficiencies.	*CO4*	*PO2*	**10**

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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PEDUT **Max Marks: 100**
Course: Drones and UAV Technology

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		Discuss the DGCA classifications of UAVs.	CO1	PO1	**05**
	b)		List any five applications of UAV.	CO1	PO1	**05**
	c)		Explain the Anatomy of a Multi-rotor drone.	CO1	PO1	**10**
			UNIT - II			
2	a)		Explain the physical properties and structure of the atmosphere with a sketch.	CO2	PO1	**10**
	b)		Explain the various types of aerodynamic forces acting on a fixed wing UAS.	CO2	PO2	**10**
			OR			
3	a)		Define and explain angle of attack and Mach number. Discuss the different flight regimes.	CO2	PO1	**10**
	b)		With a sketch explain the Aerodynamic-aero foil nomenclature and give any 3 geometry examples.	CO2	PO1	**10**
			UNIT - III			
4	a)		Explain Active sensing and Passive sensing.	CO3	PO1	**10**
	b)		Illustrate the working of Light Detection and Ranging (LiDAR) and its effect on overall performance of the system.	CO3	PO1	**10**
			OR			
5	a)		Explain the working of GPS.	CO2	PO1	**10**
	b)		Illustrate the working of Infrared and Thermal sensors.	CO3	PO2	**10**
			UNIT - IV			
6	a)		Show the working of gas turbine with sketch.	CO6	PO2	**10**
	b)		Illustrate the working of Solar cells and Fuel cells in UAVs.	CO6	PO2	**10**

			UNIT - V			
	7	a)	List various safety and privacy concerns in the use of UAVs.	*CO5*	*PO1*	**10**
		b)	Explain the use of UAVs for population assessment.	*CO5*	*PO2*	**10**

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B. M. S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PEEHV / 21ME5DEEV1 **Max Marks: 100**
Course: Electric and Hybrid Vehicles / Electric and Hybrid Vehicles - 1

Instructions: 1.Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Discuss the relative advantages and disadvantages of an EV over an ICEV.	*CO1*	*PO1*	**05**
	b)	Define Volumetric energy density, Gravimetric energy density and power density.Explain their significance.	*CO1*	*PO1*	**05**
	c)	A decent sized Petrol four-wheeler consume 15 kms per litre and Equivalent EV consume 150 Wh / km with battery cells being 250 Wh/kg and 500 Wh/ltr. Petrol energy is 45 megajoules per kilogram (MJ/kg) and its density is 0.75 kg/L. Compute i)the ratio of Energy Efficiency of EV Vs ICE (Internal Combustion Engine) vehicle ii)Ratio of Battery weight and petrol weight per km of travel by two vehicles iii)Ratio of Battery volume and petrol volume per km of travel by two vehicles Based on this, comment on the advantage and disadvantages of EV	*CO1*	*PO2*	**10**
		OR			
2	a)	List important common parts of ICE vehicle and EV. Also list components to be modified and removed from ICE vehicle to EV.	*CO1*	*PO1*	**06**
	b)	With the help of block diagram explain the working of Series and parallel hybrid vehicles.	*CO1*	*PO1*	**06**
	c)	Sketch different types of EV Configuration.	*CO1*	*PO1*	**08**
		UNIT - II			
3	a)	A vehicle needs to reach maximum speed vf in T seconds. Derive expressions for average power and peak power i) if it accelerates linearly. ii)if it accelerates at a rate “a1” for first T/2 time and at a rate “a1/2” from T/2 to T. Hence prove that peak power reduces to 2/3 rd of the peak power required for linear acceleration	*CO2*	*PO2*	**12**

	b)	Compute Forces due to drag, rolling resistance and gradient for the following vehicle assuming ρ = 1.2 (kg/m3) and θ = 8°. For the three vehicles given in the table, find Aerodynamic drag at velocity v1 and v2; also find rolling resistance at two velocities. Vehicle | GVW (kg) | C_D | Area(sqm) | μ | v1(kmph) | v2(kmph) | Tyre radius (m) 4-wheeler | 1500 | 0.3 | 2.5 | 0.015 | 30 | 80 | 0.3	*CO2*	*PO2*	**08**
		UNIT - III				
4	a)	What are the different Parameters to be considered to select EV battery? Describe in detail.	*CO3*	*PO1*	**08**
	b)	Mention different methods to measure SoC. Explain SoC estimation using Coulomb Count.	*CO3*	*PO1*	**08**
	c)	A 3.5V battery is at 2.7V at SoC of 0% and 4.3V at SoC of 100%. This implies the voltage of the battery lies in between 3.5 ±Δ% volts. What is Δ?	*CO3*	*PO2*	**04**
		OR			
5	a)	Explain the Factors affecting Battery cell life cycles with graphs.	*CO3*	*PO1*	**08**
	b)	With a sketch explain the Six parameters of NCA and NMC.	*CO3*	*PO1*	**06**
	c)	Explain the construction of the following battery packs- Prismatic, Cylindrical Cells, and Pouch cells	*CO3*	*PO1*	**06**
		UNIT - IV			
6	a)	Explain Building mSnP battery pack and nPmS battery pack with example.	*CO3*	*PO1*	**10**
	b)	A battery pack needs 15 kWh with nominal voltage at 350V. The cells that one has are 3.65V, 14 Ah Li Ion cells. i. Suggest nPmS configuration to achieve the pack requirements. ii. Find the total number of cells. iii.A cell in module of n parallel cells fails in open during operation. Find the resultant nominal pack voltage in V, pack capacity (Ah).	*CO3*	*PO2*	**10**
		UNIT - V			
7	a)	With a block diagram explain the level 1 and level 2 AC chargers for EV	*CO4*	*PO1*	**08**
	b)	Why Standardize battery charging? What are the Parameters that need Standardization, explain	*CO4*	*PO1*	**08**
	c)	Explain economics of Public Chargers in Indian Context.	*CO4*	*PO1*	**04**

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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PENTM **Max Marks: 100**
Course: Non-Traditional Machining

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		Write the classification of non-traditional machining.	CO1	PO1	**04**
	b)		Discuss the advantages and disadvantages associated with non-traditional machining.	CO1	PO1	**06**
	c)		What are the various process parameters affecting material removal rate in ultrasonic machining?	CO1	PO1	**10**
			UNIT - II			
2	a)		Explain the significance of the processing parameters in abrasive water jet machining (AWJM). How do variations in parameters affect the cutting performance in AWJM?	CO2	PO1	**08**
	b)		What are the primary applications of abrasive water jet machining?	CO2	PO1	**04**
	c)		Discuss the capabilities of abrasive flow machining along with the advantages and disadvantages of the process.	CO2	PO1	**08**
			UNIT - III			
3	a)		Differentiate between electrochemical machining and chemical machining processes.	CO3	PO1	**08**
	b)		Explain the working principle of electric discharge machining with a neat sketch.	CO3	PO1	**08**
	c)		Discuss the practical applications of wire electric discharge machining.	CO3	PO1	**04**
			OR			
4	a)		Explain the working principle of electrochemical machining with a neat sketch.	CO3	PO1	**08**
	b)		Discuss the construction of wire-electric discharge machining with a neat sketch.	CO3	PO1	**08**

		c)	Discuss the practical applications of chemical machining process.	*CO3*	*PO1*	**04**
			UNIT - IV			
	5	a)	Explain the working principle of plasma arc cutting with a neat sketch.	*CO3*	*PO1*	**08**
		b)	Discuss in detail the industrial applications of laser drilling and laser welding.	*CO3*	*PO1*	**08**
		c)	List the various process parameters considered in electron beam machining.	*CO3*	*PO1*	**04**
			OR			
	6	a)	Explain the working principle of electron beam machining with a neat sketch.	*CO3*	*PO1*	**08**
		b)	Suggest the materials that are appropriate for deburring through thermal energy method. Elaborate on the overall advantages associated with this specific deburring process.	*CO3*	*PO1*	**08**
		c)	List the various process parameters considered in laser processing methods.	*CO3*	*PO1*	**04**
			UNIT - V			
	7	a)	Explain the processing of metallization and packaging of integrated circuits.	*CO4*	*PO1*	**08**
		b)	Discuss the advantages and disadvantages of selective laser sintering.	*CO4*	*PO1*	**08**
		c)	Outline the advantages and disadvantages of laminated object manufacturing.	*CO4*	*PO1*	**04**

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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PEPOM **Max Marks: 100**
Course: Production and Operations Management

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Describe the operations management elements from various schools of management.	CO1	PO1	**10**
	b)	Elaborate the forced choice model for of strategic planning for operations.	CO1	PO2	**10**
		UNIT - II			
2	a)	Describe the capacity planning modeling with examples.	CO2	PO2	**10**
	b)	Explain the decision to be made in capacity planning with examples.	CO2	PO2	**10**
		UNIT - III			
3	a)	Describe the forecasting and operations sub-system with the help of as flow chart.	CO2	PO1	**10**
	b)	A firm uses simple exponential smoothening with α=0.1 The forecast for week ending FEB 1st was 500 units whereas the actual demand turned out to be 450 units. • Forecast the demand for week ending Feb 08. • Assume the actual demand during the week ending Feb 08 turned out to be 505 units. Forecast demand for week ending Feb 15. Continue the forecasting through March 15, assuming the actual demands were 516, 488, 467, 554 and 510 units subsequently.	CO2	PO1	**10**
		OR			
4	a)	Explain with relevant examples the priority sequencing rules in modern manufacturing and service industries.	CO3	PO1	**10**
	b)	Explain the characteristics and goals of flexible manufacturing systems.	CO3	PO1	**10**

			UNIT – IV			
	5	a)	Discuss in brief the objectives and requirements of purchasing.	*CO4*	*PO1*	**10**
		b)	Apply the concepts of value engineering to any industry and explain the characteristics of the same.	*CO4*	*PO1*	**10**
			OR			
	6	a)	Discuss the different types of costs involved in inventory control.	*CO4*	*PO1*	**10**
		b)	Explain behavioral pitfalls in inventory control.	*CO4*	*PO1*	**10**
			UNIT - V			
	7	a)	Elaborate on the different work measurement techniques.	*CO6*	*PO1*	**10**
		b)	Explain the concepts of effective job design and behavioral dimensions in the context of production and operations management in industries.	*CO5* *CO6*	*PO1*	**10**

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