

*Note: Answer ALL Questions**Part-A (10 x 1 = 10 Marks)*

Q. No.	Stem of the Question	M	L	CO	PO
Unit-I					
1. a)	Define Business Economics	1	1	1	1
1. b)	What is meant by National Income?	1	1	1	7
Unit-II					
1. c)	Describe Cross Elasticity of Demand	1	2	2	12
1. d)	What are the Determinants of supply?	1	1	2	7
Unit-III					
1. e)	Explain Monopolistic Competition	1	2	3	7
1. f)	What is meant by Marginal Cost?	1	1	3	11
Unit-IV					
1. g)	Describe Accounting Equation	1	2	4	11
1. h)	What is meant by Materiality Convention?	1	1	4	8
Unit-V					
1. i)	Explain Liquidity	1	2	5	11
1. j)	List Profitability ratios	1	1	5	11

Part-B (5 x 10=50 Marks)

Q. No.	Stem of the Question	M	L	CO	PO
Unit-I					
2. a)	Explain different sources of capital.	5	2	1	1
2. b)	Describe the advantages and disadvantages of sole proprietorship.	5	2	1	7
OR					
2. c)	Explain the nature and scope of Business Economics.	5	2	1	7
2. d)	Differentiate between Private Limited Companies and Public Limited Companies	5	4	1	7
Unit-II					
3. a)	Describe Law of Demand and its exceptions	5	2	2	11
3. b)	Explain the Determinants of Supply and supply function.	5	2	2	7
OR2					
3. c)	The quantity demanded for the product X is 30 units, when the price is Rs.15. The quantity demanded increased to 40 units, as price decreased to Rs. 10. Compute Price Elasticity of demand.	5	3	2	2
3. d)	Explain different methods of Demand Forecasting	5	2	2	12
Unit-III					
4. a)	How can a producer determine the least-cost combination of inputs?	5	1	3	3
4. b)	Differentiate between perfect competition and monopoly competition.	5	4	3	8
OR					
4. c)	Explain Law of Variable Proportions with the help of graph.	5	2	3	7
4. d)	Describe various Pricing strategies used by modern business organizations.	5	2	3	5
Unit-IV					
5. a)	Classify the following accounts into various (Personal, Real or Nominal) types of accounts. i) Salary account ii) Outstanding wages account iii) Rent account	5	2	4	11

	iv) Bank account v) Insurance prepaid vi) Drawings account vii) Bad debts account viii) Machinery account ix) Furniture account x) Patents account																																																													
5. b)	Journalise the following transactions: Jan 1, 2021 Commenced with Cash Rs. 8,00,000 Jan 3, 2021 Purchased Goods worth Rs. 1,50,000 Jan 8, 2021 Sold Goods to Mr. Ramu Rs. 1,10,000 Jan 30, 2021 Salaries paid Rs. 40,000 Jan 30, 2021 Rent paid Rs. 20,000	5	3	4	11																																																									
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5. c)	Explain Double Entry System and its advantages	5	2	4	11																																																									
5. d)	Prepare Trading and Profit and Loss account from the following information. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="3" style="text-align: center;">Trial Balance as on 31.03.2021</th> </tr> <tr> <th style="text-align: center;">Particulars</th> <th style="text-align: center;">Debit(₹)</th> <th style="text-align: center;">Credit(₹)</th> </tr> </thead> <tbody> <tr> <td>Capital</td> <td></td> <td style="text-align: right;">1,00,000</td> </tr> <tr> <td>Purchases</td> <td style="text-align: right;">40,000</td> <td></td> </tr> <tr> <td>Furniture</td> <td style="text-align: right;">30,000</td> <td></td> </tr> <tr> <td>Interest received</td> <td></td> <td style="text-align: right;">3,000</td> </tr> <tr> <td>Cash</td> <td style="text-align: right;">15,000</td> <td></td> </tr> <tr> <td>Debtors</td> <td style="text-align: right;">27,000</td> <td></td> </tr> <tr> <td>Office Stationery</td> <td style="text-align: right;">3,000</td> <td></td> </tr> <tr> <td>Machinery</td> <td style="text-align: right;">70,000</td> <td></td> </tr> <tr> <td>Bank Loan</td> <td></td> <td style="text-align: right;">5,000</td> </tr> <tr> <td>Bills Payable</td> <td></td> <td style="text-align: right;">2,000</td> </tr> <tr> <td>Opening Stock</td> <td style="text-align: right;">10,000</td> <td></td> </tr> <tr> <td>Sales</td> <td></td> <td style="text-align: right;">90,000</td> </tr> <tr> <td>Wages paid</td> <td style="text-align: right;">600</td> <td></td> </tr> <tr> <td>Salaries paid</td> <td style="text-align: right;">2,500</td> <td></td> </tr> <tr> <td>Electricity charges</td> <td style="text-align: right;">1,200</td> <td></td> </tr> <tr> <td>Insurance paid</td> <td style="text-align: right;">700</td> <td></td> </tr> <tr> <td style="text-align: right;">Total</td> <td style="text-align: right;">2,00,000</td> <td style="text-align: right;">2,00,000</td> </tr> </tbody> </table> <p>Adjustments: i) Closing Stock ₹ 12,000 ii) Depreciate Machinery @10% p.a. iii) Salaries outstanding ₹ 500</p>	Trial Balance as on 31.03.2021			Particulars	Debit(₹)	Credit(₹)	Capital		1,00,000	Purchases	40,000		Furniture	30,000		Interest received		3,000	Cash	15,000		Debtors	27,000		Office Stationery	3,000		Machinery	70,000		Bank Loan		5,000	Bills Payable		2,000	Opening Stock	10,000		Sales		90,000	Wages paid	600		Salaries paid	2,500		Electricity charges	1,200		Insurance paid	700		Total	2,00,000	2,00,000	5	3	4	11
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Unit-V																																																														
6. a)	How accounting ratios are useful in the inter-firm comparison.	5	1	5	10																																																									
6. b)	From the given Balance Sheet calculate: a) Debt-equity ratio b) Liquidity ratio c) Fixed assets to current assets ratio and d) Fixed assets to Net worth ratio. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="4" style="text-align: center;">Balance Sheet</th> </tr> <tr> <th style="text-align: center;">Liabilities</th> <th style="text-align: center;">Rs.</th> <th style="text-align: center;">Assets</th> <th style="text-align: center;">Rs.</th> </tr> </thead> <tbody> <tr> <td>Share Capital</td> <td style="text-align: right;">1,00,000</td> <td>Goodwill</td> <td></td> </tr> <tr> <td></td> <td style="text-align: right;">0</td> <td></td> <td style="text-align: right;">60,000</td> </tr> </tbody> </table>	Balance Sheet				Liabilities	Rs.	Assets	Rs.	Share Capital	1,00,000	Goodwill			0		60,000	5	3	5	10																																									
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	Retained Earnings	10,000	Machinery	1,00,000				
	Profit and loss a/c	40,000	Stock	30,000				
	Secured loans	80,000	Debtors	70,000				
	Creditors	40,000	Furniture	10,000				
	Provision for taxation	30,000	Cash	30,000				
		3,00,000		3,00,000				

OR

6. c)	Differentiate Liquidity ratios and leverage ratios.	5	4	5	11																																												
6. d)	The Balance Sheet of ABC Limited as on 31-03-2018 was as follows:	5	3	5	11																																												
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Liabilities</th> <th style="width: 15%;">Amount (₹)</th> <th style="width: 30%;">Assets</th> <th style="width: 15%;">Amount (₹)</th> </tr> </thead> <tbody> <tr> <td>Equity Share Capital</td> <td>1,40,000</td> <td>Plant and Machinery</td> <td>1,24,000</td> </tr> <tr> <td>Reserves and Surplus</td> <td>1,28,000</td> <td>Land and Buildings</td> <td>1,30,000</td> </tr> <tr> <td>Debentures</td> <td>1,32,000</td> <td>Furniture & Fixtures</td> <td>26,000</td> </tr> <tr> <td>Creditors</td> <td>26,000</td> <td>Stock</td> <td>2,000</td> </tr> <tr> <td>Bank overdraft</td> <td>4,000</td> <td>Debtors</td> <td>22,000</td> </tr> <tr> <td>Provision for Taxation:</td> <td>6,000</td> <td>Investments</td> <td>4,000</td> </tr> <tr> <td>Outstanding Expenses</td> <td>2,000</td> <td>(Short-term)</td> <td>12,000</td> </tr> <tr> <td>Bills payable</td> <td>2,000</td> <td>Cash</td> <td>65,000</td> </tr> <tr> <td></td> <td>440,000</td> <td>Cash at Bank</td> <td>55,000</td> </tr> <tr> <td></td> <td></td> <td></td> <td>440,000</td> </tr> </tbody> </table>	Liabilities	Amount (₹)	Assets	Amount (₹)	Equity Share Capital	1,40,000	Plant and Machinery	1,24,000	Reserves and Surplus	1,28,000	Land and Buildings	1,30,000	Debentures	1,32,000	Furniture & Fixtures	26,000	Creditors	26,000	Stock	2,000	Bank overdraft	4,000	Debtors	22,000	Provision for Taxation:	6,000	Investments	4,000	Outstanding Expenses	2,000	(Short-term)	12,000	Bills payable	2,000	Cash	65,000		440,000	Cash at Bank	55,000				440,000				
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	From the above, compute and interpret a) Current Ratio b) Quick Ratio c) Absolute Liquid Ratio d) Debt-Equity Ratio e) Proprietary Ratio.																																																

M: Marks; L: Bloom's Taxonomy Level; CO: Course Outcome; PO: Programme Outcome



Subject Title: Dynamics of Machinery

Time: 3 hours

Subject Code: ME501PC

Max. Marks : 60

Note: Answer ALL Questions

Part-A (10 x 1 = 10 Marks)

Q. No.	Stem of the Question	M	L	CO	PO
Unit-I					
1. a)	What is the principal of gyroscope	1	1	1	1
1. b)	Define the term inertia force and inertia torque	1	1	1	2
Unit-II					
1. c)	What is meant by expression friction circle?	1	1	2	1
1. d)	What is meant by expression friction circle?	1	2	2	1
Unit-III					
1. e)	What is meant by turning moment diagram or crank effort diagram?	1	1	3	2
1. f)	Explain the terms 'fluctuation of energy' and 'fluctuation of speed' as applied to flywheels.	1	1	3	2
Unit-IV					
1. g)	What is meant by balancing of rotating masses?	1	1	4	2
1. h)	Write a short note on primary balancing	1	1	4	2
Unit-V					
1. i)	What are the causes and effects of vibrations?	1	1	5	12
1. j)	What do you meant by logarithmic decrement?	1	1	5	1

Part-B (5 x 10=50 Marks)

Q. No.	Stem of the Question	M	L	CO	PO
Unit-I					
2. a)	Derive an expression for gyroscopic couple in standard form.	5	4	1	1
2. b)	The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship. when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h	5	3	1	1
OR					
2. c)	A slider-crank mechanism with the following dimensions is acted upon by a force $F=2\text{kN}$ at B as shown in Figure. Take $OA = 100\text{ mm}$ and $AB = 450\text{ mm}$. Determine the input torque 'T' on the link OA for the static equilibrium of the mechanism for the given configuration.	10	2	1	1
Unit-II					
3. a)	Which of the two assumptions-uniform intensity of pressure or uniform rate of wear, would you make use of in designing friction clutch and why?	5	1	2	6
3. b)	A bicycle and rider of mass 100 kg are travelling at the rate of 16 km/h on a level road. A brake is applied to the rear wheel which is 0.9 m in diameter and this is the only resistance acting. How far will the bicycle travel and how many turns will it make before it comes to	5	3	2	12

	rest? The pressure applied on the brake is 100 N and $\mu = 0.05$.				
OR					
3. c)	A conical pivot with angle of cone as 120°, supports a vertical shaft of diameter 300 mm. it is subjected to a load of 20 kN. The coefficient of friction is 0.05 and the speed of shaft is 210 rpm. Calculate the power lost in friction assuming (i) uniform pressure (ii) uniform wear	5	2	2	1
3. d)	A band and block brake has 14 blocks. Each block subtends an angle of 14° at the center of the rotating drum. The diameter of the drum is 750 mm and the thickness of the blocks is 65mm. The two ends of the band are fixed to the pins on the lever at distance of 50 mm and 210 mm from the fulcrum on the opposite sides. Determine the least force required to be applied at the lever at a distance of 600 mm from the fulcrum if the power absorbed by the blocks is 180 kW at 175 rpm. Coefficient of friction between the block and the drum is 0.35.	5	1	2	2
Unit-III					
4. a)	The turning moment requirement of a machine is represented by the equation $T = (1000 + 500 \sin 2\theta - 300 \cos 2\theta)$ N-m. Where θ is the angle turned by the crankshaft of the machine? If the supply torque is constant, determine: i) The moment of inertia by the flywheel. The total fluctuation of speed is not to exceed one percent of the mean speed of 300 rpm. ii) Angular acceleration of the flywheel when the crankshaft has turned through 45° from the beginning of the cycle. iii) The power required to drive the machine.	10	1	3	1
OR					
4. c)	State the different types of governors. Explain about any one of them	4	3	3	12
4. d)	The following particulars refer to a Wilson-Hartnell governor: Mass of each ball = 2 kg; minimum radius = 125 mm ; maximum radius = 175 mm ; minimum speed = 240 rpm ; maximum speed = 250 rpm ; length of the ball arm of each bell crank lever = 150 mm; length of the sleeve arm of each bell crank lever = 100 mm ; combined stiffness of the two ball springs = 0.2 kN/m. Find the equivalent stiffness of the auxiliary spring referred to the sleeve.	6	4	3	12
Unit-IV					
5. a)	The following data refer to two cylinder locomotive with cranks at 90°: Reciprocating mass per cylinder = 300 kg ; Crank radius = 0.3 m ; Driving wheel diameter = 1.8 m ; Distance between cylinder centre lines = 0.65 m ; Distance between the driving wheel central planes = 1.55 m. Determine i) the fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 kmph, ii) the variation in tractive effort and iii) the maximum swaying couple.	10	1	4	2
OR					
5. c)	Four masses M1, M2, M3 and M4 are 200kg, 300kg, 240kg and 260kg respectively. The corresponding radii of rotation are 0.2m, 0.15m, 0.25m and 0.3m respectively and the angle between successive masses are 45°, 75° and 135°. Find the position and magnitude of balance mass required if its radius of rotation is 0.25m.	10	1	4	2
Unit-V					
6. a)	Derive an equation for the natural frequency of free transverse vibration of a shaft headed with a number of concentrated loads, by energy method.	5	4	5	2
6. b)	Discuss briefly with neat sketches the longitudinal, transverse and torsional free vibrations	5	1	5	1

OR

6. c)	Derive an equation for the natural frequency of free vibration by energy method	5	3	5	1
6. d)	A shaft, 1.5 m long, supported by flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m ³ and its modulus of elasticity is 200 GN/m ² . Find the lowest whirling speed of the shaft, taking into account the mass of the shaft.	5	1	5	1

M: Marks; L: Bloom's Taxonomy Level; CO: Course Outcome; PO: Programme Outcome



Subject Title: Thermal Engineering -II

Time: 3 hours

Subject Code: ME502PC

Max. Marks : 60

*Note: Answer ALL Questions**Part-A (10 x 1 = 10 Marks)*

Q.No.	Stem of the Question	M	L	CO	PO
Unit-I					
1. a)	Draw T-S diagrams of Rankine Cycle.	1	1	1	1
1. b)	Differentiate between fire tube and water tube boiler	1	2	1	1
Unit-II					
1. c)	Classify nozzles used in steam turbines	1	1	2	1
1. d)	Define isentropic efficiency of Nozzle.	1	2	2	1
Unit-III					
1. e)	Define stage efficiency of a steam turbine.	1	2	3	1
1. f)	Define Degree of reaction in reaction turbine	1	1	3	1
Unit-IV					
1. g)	Differentiate between surface condenser and jet condenser.	1	1	4	1
1. h)	Draw the line diagram of a closed cycle gas turbine.	1	2	4	1
Unit-V					
1. i)	Define thrust in jet propulsion systems	1	1	5	1
1. j)	List the methods used for thrust augmentation in turbojet engines	1	2	5	1

Part-B (5 x 10=50 Marks)

Q. No.	Stem of the Question	M	L	CO	PO
Unit-I					
2. a)	Explain regenerative cycle with neat sketch and also draw the T-s and h-s diagrams.	5	2	1	1
2. b)	A simple Rankine cycle works between pressures 28 bar and 0.06 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption.	5	2	1	2
OR					
2. c)	What is fire tube boiler and explain Lancashire boiler with neat sketch?	5	2	1	1
2. d)	A chimney has a height of 24 m. The ambient temperature is 25°C. Temperature of flue gases passing through the chimney is 300°C. If air flow through the combustion space is 20 kg/kg of fuel burned, find: (i) the theoretical draught in mm of water, (ii) Velocity of the flue gases passing through the chimney.	5	4	1	2
Unit-II					
3. a)	Derive expression for critical pressure ratio for steam flow through nozzle	5	2	2	2
3. b)	Determine throat area, exit area and exit velocity for a steam nozzle to pass 0.2 kg/s when the inlet conditions are 12 bar and 250°C and the final pressure is 2 bar. Assume that expansion is isentropic and inlet velocity is negligible. Take $n = 1.3$ for superheated steam.	5	4	2	2
OR					
3. c)	Explain the effect of friction in nozzle flow with the help of h-s diagram.	5	2	2	2
3. d)	In a convergent-divergent nozzle, the steam enters at 15 bar and 300°C and leaves at a pressure of 2 bar. The inlet velocity to the nozzle is 150 m/s. Find the required throat and exit areas for a mass flow rate of 1 kg/s. Assume nozzle efficiency to be 90 percent and	5	4	2	2

	$C_{ps} = 2.4 \text{ kJ/kg.K.}$				
Unit-III					
4. a)	What do you mean by compounding of steam turbines? List out the various methods and discuss at least one method with neat sketch	5	2	3	2
4. b)	A single-row impulse turbine develops 140.5 kW at a blade speed of 175 m/s when the steam flow rate is 120 kg/min. Steam leaves the nozzle at 400 m/s. Take blades velocity coefficient = 0.9 and assume that the steam leaves the turbine blades axially. Find out the nozzle angle, blade angles. Assume there is no shock.	5	3	3	2
OR					
4. c)	Derive the expression for maximum efficiency of reaction turbine	5	2	3	2
4. d)	In a 50% reaction turbine stage running at 2800 r.p.m, the exit angles are 25° and inlet angles are 50° . The mean diameter is 1.2 m. The steam flow rate is 11000 kg/min and stage efficiency is 80%. Determine: (i) Power output of the stage (ii) The specific enthalpy drop in the stage	5	4	3	2
Unit-IV					
5. a)	Explain working principle of Surface Condenser with neat sketch.	5	2	4	1
5. b)	During a trial on a steam condenser, the following observations were recorded. Condenser vacuum 680 mm Hg, barometer reading 764 mm Hg, mean temperature 36.2°C , hot well temperature 36°C , condensate formed per hour 1780 kg, circulating water inlet temperature 20°C , circulating cooling water outlet temperature 32°C and quantity of cooling water 1250 kg/min. calculate (i) mass of air present per kg of condensed steam (ii) condition of steam as it enters the condenser (iii) vacuum efficiency.	5	4	4	3
OR					
5. c)	Explain closed cycle gas turbine plant with a neat sketch	5	2	4	1
5. d)	In gas turbine plant working on Brayton cycle the air at inlet is at 27°C , 0.1MPa. The pressure ratio is 6.25 and maximum temperature is 800°C . The turbine and compressor efficiencies are each 80%. Find (i) compressor work/kg of air (ii) turbine work/kg of air (iii) cycle efficiency (iv) the turbine exhaust temperature.	5	4	4	2
Unit-V					
6. a)	Explain ram-jet engine with the help of neat sketch	5	2	5	1
6. b)	A turbo jet engine flying at a speed of 960km/h consumes air at the rate of 54.5 kg/s. Calculate: (i) exit velocity of jet when the enthalpy change for the nozzle is 200 kJ/kg and velocity coefficient is 0.97, (ii) fuel flow rate in kg/s when air fuel ratio is 75:1, (iii) thrust specific fuel consumption, (iv) propulsive power, (v) propulsive efficiency.	5	4	5	2
OR					
6. c)	Give the detailed classification of rocket engines. Explain with the help of neat sketch liquid propellant rocket engines.	5	2	5	2
6. d)	The effective jet exit velocity of a rocket is 3500 m/s, the forward flight velocity is 1250 m/s, and the propellant consumption is 75 kg/s. Calculate: i) The thrust; ii) The thrust power and iii) The propulsive efficiency.	5	4	5	2

M: Marks; L: Bloom's Taxonomy Level; CO: Course Outcome; PO: Programme Outcome



MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech.V Semester End Examinations
(Mechanical Engineering)
(Model Question Paper)

MR-22

Subject Title: Design of Machine Members-I
Time: 3 hours

Subject Code: ME503PC
Max. Marks: 60

Note: Answer ALL Questions
Part-A (10 x 1 = 10 Marks)

Q. No.	Stem of the Question	M	L	CO	PO
Unit-I					
1. a)	Define simple stress	1	1	1	1
1. b)	Define Factor of safety	1	1	1	1
Unit-II					
1. c)	Explain about endurance limit	1	2	2	2
1. d)	Explain about Notch sensitivity	1	2	2	2
Unit-III					
1. e)	Discuss the various types of welded joints	1	1	3	1
1. f)	What are the terms used in riveted joints.	1	1	3	1
Unit-IV					
1. g)	Discuss the various types of cotter joints	1	1	4	1
1. h)	Discuss the various types of keys	1	1	4	1
Unit-V					
1. i)	Classify the shaft couplings	1	1	5	1
1. j)	What type of stresses are induced in shafts?	1	1	5	1

Part-B (5 x 10=50 Marks).

Q. No.	Stem of the Question	M	L	CO	PO
Unit-I					
2. a)	A mild steel shaft of 60 mm diameter is subjected to a bending moment of 2000 N-m and a torque (T). If the yield point of the steel in tension is 210 MPa, find the maximum value of the torque without causing yielding of the shaft according to (a) maximum shear stress theory (b) maximum shear strain energy theory.	10	2	1	4
OR					
2. c)	A hollow shaft is required to transmit 600 kW at 110 rpm. The maximum torque 20% greater than the mean. The shear stress is not to exceed 63 N/mm ² and the twist in a length of 3 meters not to exceed 1.4 degrees. Find the external diameter of the shaft, if the internal diameter to external diameter is 3/8. Take rigidity modulus as 84 GN/m ² .	5	2	1	3
2. d)	Explain about Preferred numbers	5	2	1	2
Unit-II					
3. a)	A circular bar of 500 mm length is supported freely on its two ends. It is acted upon by a central concentrated dynamic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of the bar by using a factor of safety as 1.5, size effect of 0.85, surface finish factor of 0.9, the material properties of the bar are given by ultimate strength of 650 N/mm ² , yield strength of 500 N/mm ² and endurance strength of 350 N/mm ²	10	3	2	3
OR					

P.T.O.

3. c)	A steel rod is subjected to a reversed axial load of 180 kN. Find the diameter of the rod for a factor of safety of 2. Neglect the column action. The material has an ultimate tensile strength of 1070 N/mm ² and yield strength of 910 N/mm ² . The endurance limit in reversed bending may be assumed to be one-half of the ultimate tensile strength. Other correction factors may be taken as; for axial loading as 0.7; for machined surface as 0.8; for size as 0.85; for stress concentration as 1.0	5	2	2	3
3. d)	Explain the methods to reduce stress concentration in machine members	5	2	2	2
Unit-III					
4. a)	Double riveted lap joint with zig-zag riveting is to be designed for 13 mm thick plates. Assume permissible tensile, shear and crushing stresses of the material are 80 N/mm ² , 60 N/mm ² and 120 N/mm ² respectively. Also, find the efficiency of the joint.	5	2	3	2
4. b)	Explain design procedure for eccentric loaded welded joint	5	2	3	2
OR					
4. c)	For supporting the travelling crane in a workshop, the bracket are fixed on steel column .The maximum load that comes on the bracket is 12 kN acting vertically at a distance of 400 mm from the face of the column. The vertical face of the bracket is secured to a column by four bolts, in two rows (two in each row) at a distance of 50 mm from the lower edge of the bracket. Determine the size of the bolts if the permissible value of the tensile stress for the bolt material is 84 MPa. Also find the cross section of the arm of the bracket which is rectangular.	10	3	3	3
Unit-IV					
5. a)	Design a sleeve and cotter joint to resist a tensile load of 60 kN. All parts of the joint are made of the same material with the following allowable stresses: Tensile stress = 60 MPa, shear stress =70 MPa, and crushing stress= 125 MPa.	10	3	4	3
OR					
5. c)	A rectangular sunk key 14 mm wide, 10 mm thick and 75 mm long is required to transmit 1200 N-m torque from a 50 mm diameter solid shaft. Determine whether the length is sufficient or not, if the permissible shear stress and crushing stresses are limited to 56 MPa and 168 MPa respectively.	5	2	4	4
5. d)	Explain Design Procedure for Socket and spigot joint	5	3	4	3
Unit-V					
6. a)	A solid circular shaft is subjected to a bending moment of 3000 N-m and a torque of 10 000 N-m. The shaft is made of steel having ultimate tensile stress of 700 MPa and ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of the shaft.	5	2	5	3
6. b)	Explain Design Procedure for split muff coupling	5	3	5	3
OR					
6. c)	Design a muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 rpm. The material for the shafts and key is plain carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 MPa.	10	2	5	3

M: Marks; L: Bloom's Taxonomy Level; CO: Course Outcome; PO: Programme Outcome



Subject Title: Operations Research

Time: 3 hours

Subject Code: ME504PC

Max. Marks : 60

Note: Answer ALL Questions

Part-A (10 x 1 = 10 Marks)

Q. No.	Stem of the Question	M	L	CO	PO
Unit-I					
1. a)	State the characteristics of the standard form of an LPP	1	1	1	1
1. b)	Differentiate between slack and surplus variable	1	2	1	1
Unit-II					
1. c)	What do you mean by degeneracy in Transportation Problem	1	2	2	1
1. d)	What do you understand by balanced Assignment Problem	1	2	2	1
Unit-III					
1. e)	What do you mean by "No Passing Rule" in sequencing Problems	1	2	3	1
1. f)	What do you understand by group replacement?	1	2	3	1
Unit-IV					
1. g)	Distinguish the terms minimax and maximin with reference to rectangular games.	1	2	4	1
1. h)	Classify the inventory	1	1	4	1
Unit-V					
1. i)	What do you understand by (M/M/1): (FCFS/ ∞/∞) queuing model?	1	2	5	1
1. j)	State the Bellman's principle of optimality	1	1	5	1

Part-B (5 x 10=50 Marks)

Q. No.	Stem of the Question	M	L	CO	PO																												
Unit-I																																	
2. a)	Briefly explain the characteristics of Operations Research.	5	2	1	1																												
2. b)	Discuss the various steps used in solving Operations Research problems.	5	2	1	1																												
OR																																	
2. c)	An Air force is experimenting with three types of bombs P, Q and R in which three kinds of explosives A, B and C will be used. Taking the various factors into account, it has been decided to use at the maximum 600 kg of explosive A, at least 480 kg of explosive B and exactly 540 kg of explosive C. Bomb P requires 3,2,2 kg, Bomb Q requires 1,4,3 kg and bomb R requires 4,2, 3 kg of explosives A, B and C respectively. Bomb P is estimated to give the equivalent of a 2ton explosion, bomb Q, a 3ton explosion and bomb R, a 4ton explosion respectively. Under what production schedule can the Air Force make the biggest bang? Solve the LPP using Big-M method.	10	3	1	3																												
Unit-II																																	
3. a)	Find the initial feasible solution to the following transportation problem using Vogel's Method. Cell entries in the table are unit costs.	5	2	2	2																												
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>D₁</th> <th>D₂</th> <th>D₃</th> <th>D₄</th> <th>D₅</th> <th>Supply</th> </tr> </thead> <tbody> <tr> <th>O₁</th> <td>68</td> <td>35</td> <td>4</td> <td>74</td> <td>15</td> <td>18</td> </tr> <tr> <th>O₂</th> <td>57</td> <td>88</td> <td>91</td> <td>3</td> <td>8</td> <td>17</td> </tr> <tr> <th>O₃</th> <td>91</td> <td>60</td> <td>75</td> <td>45</td> <td>60</td> <td>19</td> </tr> </tbody> </table>						D ₁	D ₂	D ₃	D ₄	D ₅	Supply	O ₁	68	35	4	74	15	18	O ₂	57	88	91	3	8	17	O ₃	91	60	75	45	60	19
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3. b)	State the steps of MODI Method for finding optimal solution in a Transportation Problem	5	1	2	1																																										
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3. c)	<p>Five workers are available to work with the machines and the respective costs (in rupees) associated with each worker machine assignment are given below. A sixth machine is available to replace one of the existing ones and the associated of that machine costs are also given below.</p> <table border="1"> <thead> <tr> <th></th> <th>M1</th> <th>M2</th> <th>M3</th> <th>M4</th> <th>M5</th> <th>M6</th> </tr> </thead> <tbody> <tr> <td>W1</td> <td>12</td> <td>3</td> <td>6</td> <td>-</td> <td>5</td> <td>9</td> </tr> <tr> <td>W2</td> <td>4</td> <td>11</td> <td>-</td> <td>5</td> <td>-</td> <td>8</td> </tr> <tr> <td>W3</td> <td>8</td> <td>2</td> <td>10</td> <td>9</td> <td>7</td> <td>5</td> </tr> <tr> <td>W4</td> <td>-</td> <td>7</td> <td>8</td> <td>6</td> <td>12</td> <td>10</td> </tr> <tr> <td>W5</td> <td>5</td> <td>8</td> <td>9</td> <td>4</td> <td>6</td> <td>1</td> </tr> </tbody> </table> <p>i) Determine whether the new machine can be accepted. ii) Also determine the optimal assignment and the associated saving in cost.</p>		M1	M2	M3	M4	M5	M6	W1	12	3	6	-	5	9	W2	4	11	-	5	-	8	W3	8	2	10	9	7	5	W4	-	7	8	6	12	10	W5	5	8	9	4	6	1	10	3	2	2
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4. a)	<p>Find the optimal sequence and idle time of each machine that minimizes total elapsed time required to complete the following tasks. The Machine sequence is PRQ. Processing time (in hours) are given in the following table.</p> <table border="1"> <thead> <tr> <th></th> <th>Tasks</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> </tr> </thead> <tbody> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Machines</td> <td>P</td> <td>4</td> <td>9</td> <td>8</td> <td>5</td> <td>10</td> <td>9</td> </tr> <tr> <td>Q</td> <td>7</td> <td>8</td> <td>6</td> <td>12</td> <td>6</td> <td>7</td> </tr> <tr> <td>R</td> <td>5</td> <td>4</td> <td>3</td> <td>6</td> <td>2</td> <td>5</td> </tr> </tbody> </table>		Tasks	A	B	C	D	E	F	Machines	P	4	9	8	5	10	9	Q	7	8	6	12	6	7	R	5	4	3	6	2	5	10	2	3	3												
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4. c)	<p>The data on the operating cost per year and resale price of equipment A whose purchase price is Rs 10,000 are given below:</p> <table border="1"> <thead> <tr> <th>Year</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> </tr> </thead> <tbody> <tr> <td>operating Cost (Rs)</td> <td>1,500</td> <td>1,990</td> <td>2,300</td> <td>2,900</td> <td>3,600</td> <td>4,500</td> <td>5,500</td> </tr> <tr> <td>Resale value (Rs)</td> <td>5,000</td> <td>2,500</td> <td>1,250</td> <td>600</td> <td>400</td> <td>400</td> <td>400</td> </tr> </tbody> </table> <p>(i) What is the optimum period for replacement? (ii) When equipment A is two years old, equipment B, which is a new model for the same usage, is available. The optimum period for replacement is four years with an average cost of Rs 3,600. Should we change equipment A with equipment B? If so, when?</p>	Year	1	2	3	4	5	6	7	operating Cost (Rs)	1,500	1,990	2,300	2,900	3,600	4,500	5,500	Resale value (Rs)	5,000	2,500	1,250	600	400	400	400	10	2	3	2																		
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5. a)	There are two players in a game, player A and Player B. Each of them randomly shows selected fingers of his right hand five fingers. If the sum of the number of fingers shown by the both the players is	5	3	4	3																																										

	even number, then the Player B has to give money in rupees equivalent to the number of fingers shown by him to the Player A, If the sum of the number of fingers shown by both the players is odd number, then the Player A has to give money in rupees equivalent to the number of fingers shown by him to the Player B. Construct the payoff matrix with respect to the Player A and find the optimal solution for this game.				
5. b)	Write short notes on (i) Two-person zero-sum fair games. (ii) Pure and mixed strategies.	5	2	4	1
OR					
5. c)	A company uses annually 24000 units of a raw material, which costs Rs. 1.25 per units. Placing each order costs Rs. 22.50 and the carrying cost is 5.4 percent per year of the average inventory. Find the economic order quantity and the total inventory costs including cost of material. Should the company accept the offer made by the supplier of a discount of 5% on the cost price on a single order of 24000 units? Suppose the company works for 300 days a year. If the procurement time is 12 days and safety stock is 400 units, find the re-order point, the minimum, maximum, and average inventory.	10	2	4	2
Unit-V					
6. a)	A harbour has single dock to unload the containers from the incoming ships. The arrival rate of ships at the harbour follows Poisson distribution and the unloading time for the ships follows exponential (negative) distribution and hence, the service rate also follows Poisson distribution. The arrival rate and the service rate are 8 ships per week and 14 ships per week, respectively. Find the following: (a) Utilization of the dock (b) Average number of waiting ships in the queue. (c) Average waiting time per ship in the queue. (d) Average number of waiting ships in the system. (e) Average waiting time per ship in the system.	5	2	5	2
6. b)	Write short notes on (i) Queue disciplines (ii) Customer behaviours in queue systems	5	2	5	1
OR					
6. c)	Solve the Following LPP using dynamic programming technique Maximize $Z = 10x_1 + 30x_2$ subject to $3x_1 + 6x_2 \leq 168$ $12x_2 \leq 240$ and $x_1, x_2 \geq 0$	10	3	5	3

M: Marks; L: Bloom's Taxonomy Level; CO: Course Outcome; PO: Programme Outcome