

CBCS SCHEME

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15ME51

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020 Management and Engineering Economics

Time: 3 hrs.

Max. Marks: 80

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of "Compounding Interest Factor" tables are permitted.*

Module-1

- 1 a. Define management and explain the levels of management. (08 Marks)
b. List and explain the various functions of management. (08 Marks)

OR

- 2 a. Explain the importance of planning. (08 Marks)
b. Explain the various steps in decision making process, with a block diagram. (08 Marks)

Module-2

- 3 a. Briefly explain the principles of organization. (08 Marks)
b. Explain techniques of selection in detail. (08 Marks)

OR

- 4 a. How does Maslow's hierarchy of needs help a manager to motivate his subordinates? Explain. (08 Marks)
b. Discuss the steps involved in a control process. (08 Marks)

Module-3

- 5 a. With neat sketch explain problem solving process. How are the decisions taken? (08 Marks)
b. Find the effective rate of interest for an actual rate of interest of 10% when compounded
i) Yearly ii) Biannually iii) Monthly iv) Daily. (08 Marks)

OR

- 6 a. Explain how to demand, how of supply and equilibrium point with suitable example. (08 Marks)
b. Sketch and explain cash flow diagram for borrower's and lender's point of view. (08 Marks)

Module-4

- 7 a. List and explain the conditions for present worth comparisons. (08 Marks)
b. Two bikes of brand 'P' and 'Q' are available on the following terms:
i) Bike 'P' → Make a down payment of Rs.5000 and then Rs.6000 at the end of each year for 7 years.
ii) Bike 'Q' → Make a downpayment of Rs.15,000 and no payment for the next 3 years. From end of the 4th year annual payments of Rs.12,000 for next 4 years.
Select the better brand based on the future worth method of comparison. If rate of interest is 10% compounded annually. (08 Marks)

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

OR

- 8 a. Define the following terms:
- Ownership life
 - Accounting life
 - Economic life.
- (06 Marks)
- b. A farm house can be purchased for Rs.90,000 and the expected resale value after 20 years is Rs.63,000. If the annual rental income is Rs.11,800 and expenses Rs.4,700 what will be the rate of returned earned on this farm house? (10 Marks)

Module-5

- 9 a. List and explain the basic methods of depreciation. (08 Marks)
- b. List and briefly explain different elements of cost required for finding selling price of the product. (08 Marks)

OR

- 10 a. Briefly explain methods of costing. (10 Marks)
- b. A C.I. stepped bar is shown in Fig.Q.10(b). Taking density of CI as 7.0208 gm/cc. Calculate unit of component. Also what is the cost of material if cost per kg is Rs.100? (06 Marks)

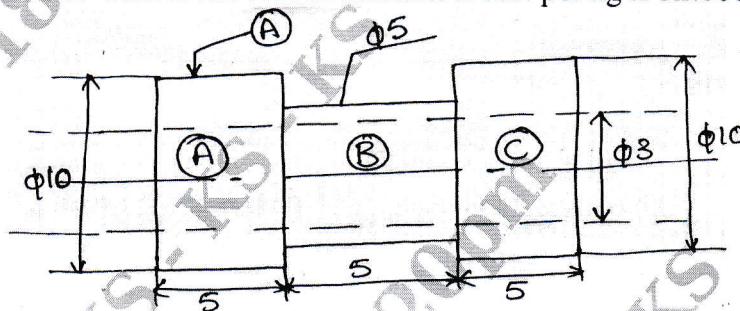


Fig.Q.10(b)

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Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020 Dynamics of Machines

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Considering slider crank mechanism, state and explain principle of virtual work. (06 Marks)
- b. A four bar mechanism shown in Fig.Q1(b) is acted by a force $P = 100, \angle 120^\circ N$ on link CD. The dimensions of the various links are $AB = 40 \text{ mm}$, $BC = 60 \text{ mm}$, $CD = 50 \text{ mm}$, $DA = 30 \text{ mm}$ and $DE = 20 \text{ mm}$. Determine the magnitude and direction of input torque T_2 on link AB for the static equilibrium of the mechanism.

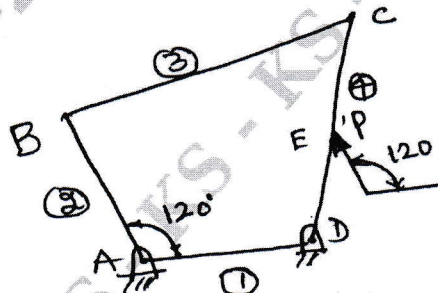


Fig.Q1(b)

(10 Marks)

OR

- 2 a. Explain in brief D'Alembert's principle and state why it is used. (06 Marks)
- b. A horizontal gas engine running at 240 rpm has a bore of 500 mm and stroke of 600 mm. The length of connecting rod is 1.2 m and mass of reciprocating parts is 200 kg. The difference between driving and back pressure is 0.4 N/mm^2 , when the crank has turned an angle of 60° from inner dead center. Neglecting the affect of piston rod, determine:
- (i) Net force on the piston or piston effort.
 - (ii) Thrust in the connecting rod
 - (iii) Pressure in the slide bars
 - (iv) Tangential force on the crank pin
 - (v) Thrust on the bearings
 - (vi) Turning movement on the crank shaft
 - (vii) Acceleration of the flywheel which has mass of 100 kg and radius of gyration of 500 mm, while the power of the engine is 100 KW. (10 Marks)

Module-2

- 3 A rotor has the following properties.

Mass	Magnitude (kg)	Radius (mm)	Angle (degrees)	Axial distances from 1 st mass (mm)
1	9 kg	100 mm	0°	-
2	7 kg	120 mm	60°	160 mm
3	8 kg	140 mm	135°	320 mm
4	6 kg	120 mm	270°	560 mm

If the shaft is balanced by two counter masses located at 100 mm radius r and revolving in planes midway of planes 1 and 2 and midway of 3 and 4, determine the magnitude of the masses and their respective angular position. (16 Marks)

OR

- 4 A four crank engine has two outer cranks set at 120° to each other and their reciprocating masses are each 400 kg. The distance between planes of rotation of adjacent cranks are 450 mm, 750 mm and 600 mm. If the engine is to be in complete balance, find the reciprocating mass and the relative angular position for each of the inner cranks. If the length of each crank is 300 mm, the length of each connecting rod is 1.2 m and the speed of rotation is 240 rpm, find maximum secondary unbalanced force. (16 Marks)

Module-3

- 5 a. Define the term stability and sensitivity of a governor. (06 Marks)
 b. In an engine governor of the porter type, the upper and lower arms are 200 mm and 250 mm respectively and pivoted on the axis of rotation. The mass of the center load is 15 kg, the mass of each ball is 2 kg and friction of sleeve together with a resistance of the operating gear is equal to a load of 25 N at the sleeve. If the limiting inclination of the upper arms to the vertical are 30° and 40° , find taking friction into account, range of speed of the governor. (10 Marks)

OR

- 6 a. With neat sketches, explain the affect of gyroscopic couple on steering, pitching and rolling of a ship. (08 Marks)
 b. An aeroplane flying at a speed of 300 kmph takes right turn with a radius of 50 meter. The mass of engine and propeller is 500 kg and radius of gyration is 400 mm. If the engine runs at 1800 rpm in clockwise direction, when viewed from tail end, determine the gyroscopic couple and state its effect on the aeroplane. What will be the effect, if the aeroplane turns to left instead of right? (08 Marks)

Module-4

- 7 a. Define the following terms:
 (i) Harmonic motion (ii) Natural frequency
 (iii) Amplitude (iv) Damping (08 Marks)
 b. Add the following harmonic motions and check the solution graphically:
 $x_1 = 2 \cos(\omega t + 0.5)$ $x_2 = 5 \sin(\omega t + 1.0)$ (08 Marks)

OR

- 8 a. Find the natural frequency of spring-mass system considering inertia effect of the mass of the spring. (08 Marks)
 b. Find the natural frequency of the Fig.Q8(b).

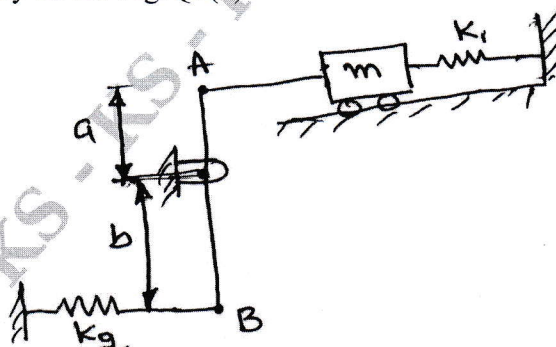


Fig.Q8(b)

(08 Marks)

Module-5

- 9 a. Define logarithmic decrement and prove that logarithmic decrement $\delta' = \frac{2\pi\xi}{\sqrt{1-\xi^2}}$ where ξ is damping ratio. (07 Marks)
- b. The measurement on a mechanical vibrating system shows that the mass of 10 kg and that the springs can be combined to give an equal spring stiffness 5 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40 N, when the mass have a unit velocity of 1 m/sec. Determine:
- Critical damping coefficient
 - Damping factor
 - Logarithmic decrement
 - Ratio of any consecutive amplitudes.
- (09 Marks)

OR

- 10 a. Write short notes on the following:
- Magnification factor
 - Transmissibility.
- (06 Marks)
- b. A single cylinder vertical diesel engine has a total mass of 100 kg is mounted on a steel chassis frame. The static deflection owing to the weight of the chassis is 3 mm. The reciprocating masses of the engine amounts to 10 kg and the stroke of the engine 80 mm. A dashpot with a damping coefficient of 2 N/mm/sec is used to dampen the vibration. Determine:
- amplitude of the vibration, if the driving shaft rotates at 1000 rpm,
 - speed of the driving shaft, when resonance occurs.
- (10 Marks)

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15ME53

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020 Turbo Machines

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Enumerate the difference between positive displacement machine and turbo machine. (04 Marks)
- b. Define static and stagnation states. (04 Marks)
- c. Air flows through an air turbine where its stagnation pressure is reduced in the ratio 5:1. The total to total efficiency is 80%. The air flow is 5 kg/s. If the total power output is 500 KW. Find:
- (i) Inlet total temperature
- (ii) Actual exit total temperature
- (iii) Actual exit static temperature if the velocity is 100 m/s
- (iv) Total to static efficiency (08 Marks)

OR

- 2 a. Show that for a turbine polytropic efficiency is given by
- $$\eta_p = \left(\frac{n-1}{n} \right) \left(\frac{\gamma}{\gamma-1} \right)$$
- where n is index of polytropic process, γ is ratio of specific heats. (08 Marks)
- b. A turbine is to operate under a head of 25m at 200 rpm. The discharge is 9 m³/s. If the efficiency is 90%, determine the performance of the turbine under a head of 20 m. (08 Marks)

Module-2

- 3 a. Show that the alternate form of Euler's turbine equation can be expressed as follows
- $$W = \frac{(v_1^2 - v_2^2) + (u_1^2 - u_2^2) + (v_{r_2}^2 - v_{r_1}^2)}{2}$$
- Draw the relevant velocity triangles. (08 Marks)
- b. Show that for maximum utilization factor of an axial flow machine with $R = \frac{1}{4}$. The speed ratio $\phi = \frac{2}{3} \cos \alpha$, where R is degree of reaction and α_1 is nozzle angle with respect to tangential direction at inlet. (08 Marks)

OR

- 4 a. A radial outward flow turbo machine has no whirl at inlet. The blade speed at exit is twice that at inlet. The radial velocity remains constant. Inlet blade angle is 45°. Show that the degree of reaction for this machine is given by $R = \frac{2 + \cot \beta_2}{4}$ where R is degree of reaction and β_2 is blade angle at exit. (08 Marks)

- b. A single stage air blower with no inlet guide vanes is running at 3600 rpm. The mean diameter of rotor is 16 cm and mass flow rate of air through the blower is 0.45 kg/s. In the rotor the air is turned through an angle of 20° towards the axial direction during the passage through the rotor at mean diameter. Assume that the axial component of fluid velocity remain constant. Determine the power input and degree of reaction. Assume that the density of air is constant at 1.185 kg/m^3 and area of flow is 0.02 m^2 . (08 Marks)

Module-3

- 5 a. What is need for compounding in stream turbines? Explain velocity compounding. (04 Marks)
- b. For a 50% reaction turbine show that $\alpha_1 = \beta_2$ and $\alpha_2 = \beta_1$ where α_1 and α_2 are inlet and outlet angles of fixed blades and β_1 and β_2 are inlet and outlet angles of moving blades. (04 Marks)
- c. In a single stage impulse turbine the nozzle angle is 25° . The absolute velocity of stream at exit is 300 m/s in a direction 120° to the direction of motion of blades assuming no axial thrust. Determine: (i) the blade angles and (ii) power developed. (08 Marks)

OR

- 6 a. Show that the maximum utilization factor of blade efficiency with equiangular blades is given by $\eta_{b \max} = \cos^2 \alpha_1$ where α_1 is the nozzle angle. (08 Marks)
- b. The following data refers to a stage of a reaction turbine. Rotor diameter 1.5 m, speed ratio 0.72, outer blade angle 20° rotor speed 3000 rpm. Determine:
 (i) Diagram efficiency
 (ii) Percentage increase in diagram efficiency and rotor speed. If the rotor is designed to run at the best theoretical speed. Assume symmetric velocity triangles. (08 Marks)

Module-4

- 7 a. Show that the maximum hydraulic efficiency of pelton wheel turbine is given by

$$\eta_{h \max} = \frac{1 + K \cos \beta_2}{2}$$

where K is blade velocity coefficient, β_2 is blade discharge angle. (08 Marks)

- b. The following data refers to a Francis turbine:
 Net head = 60 m, speed = 700 rpm, shaft power = 294.3 KW, overall efficiency = 84%, hydraulic efficiency = 93%, flow ratio = 0.20, breadth ratio = 0.1, outer diameter of runner equal twice the inner diameter. The thickness of the vane occupy 5% of circumferential area of the runner, velocity of flow is constant at inlet and outlet and the discharge is radial at outlet. Determine :
 (i) Guide blade angle
 (ii) Runner vane angle at inlet and outlet
 (iii) Diameter of runner at inlet and outlet
 (iv) Width of the wheel at inlet (08 Marks)

OR

- 8 a. Explain with neat sketch working of Francis turbine. Mention the functions of draft tube. (08 Marks)
- b. A pelton wheel is to be designed for a head of 60 m when running at 200 rpm. The pelton wheel develops 95.65 KW shaft power. The velocity of buckets = 0.45 times the velocity of jet, overall efficiency = 0.85 and coefficient of velocity = 0.98. Find:
 (i) The diameter of jet
 (ii) Diameter of wheel
 (iii) Size of buckets
 (iv) Number of buckets (08 Marks)

Module-5

- 9 a. When the pumps are arranged in series and in parallel? Explain any one arrangement. (04 Marks)
- b. Explain the phenomenon of surging in centrifugal compressors. (04 Marks)
- c. An air compressor has eight stages of equal pressure ratio 1.35. the flow rate through the compressor and its overall efficiency are 50 kg/s and 82% respectively. If the conditions of air at entry are 1.0 bar and 40°C. Determine:
- State of air at exit of compressor
 - Polytropic efficiency
 - Efficiency of each stage
 - Power required to drive the compressor, assume overall efficiency of drive as 90%. (08 Marks)

OR

- 10 a. Define slip and slip coefficient with respect to centrifugal compressor. (02 Marks)
- b. Draw the velocity diagrams at exit of a centrifugal pump for forward, radial and backward curved vanes. (06 Marks)
- c. A centrifugal pump impeller has radial vanes from inner radius of 8 cm to outer radius of 24 cm. The width of the impeller is constant and is 6 cm between the shrouds. If the speed of the pump is 1500 rpm and discharge is 250 lit/s. Find:
- Change in enthalpy
 - The outlet pressure if the inlet pressure is 0.8 kPa and water flow is outward. (08 Marks)

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15ME54

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020 Design of Machine Elements - I

Time: 3 hrs.

Max. Marks: 80

- Note:** 1. Answer FIVE full questions, choosing ONE full question from each module.
2. Use of design data handbook is permitted.
3. Missing data if any may be assumed.

Module-1

- 1 a. What is mechanical engineering design? List the steps involved in design with a block diagram. (04 Marks)
b. A 50 mm diameter steel rod supports a load of 9 kN and in addition is subjected to a torsional moment of 100 N-m as shown in Fig. Q1 (b). Determine the maximum tensile and the maximum shear stress. (08 Marks)

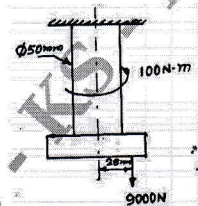


Fig. Q1 (b)

- c. Explain the reasons for stress concentration in machine members and two methods adopted to reduce the same. (04 Marks)

OR

- 2 a. A machine element in the form of a Cantilever beam has a rectangular cross section of depth 200 mm. The beam is subjected to an axial tensile load of 60 kN and a transverse load of 50 kN acting downwards at the free end of the beam which has a span of 800 mm. Determine the width of rectangular cross section if the material of the beam is steel with an allowable tensile stress of 90 N/mm². (90 MPa) (08 Marks)
b. Determine the safe load that can be carried by a bar of rectangular cross section shown in Fig. Q2 (b) limiting the maximum normal stress to 130 MPa taking stress concentration into account. (08 Marks)

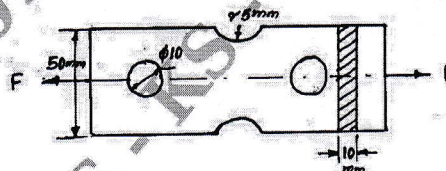


Fig. Q2 (b)

Module-2

- 3 a. Derive an expression for impact stress in an axial bar of cross section 'A' and length 'l' due to an impact load 'W' falling from a height 'h' on the bar. (06 Marks)
b. A Cantilever beam of rectangular cross section has a span of 800 mm. The rectangular cross section of the beam has a depth of 200 mm. The free end of the beam is subjected to a transverse load that fluctuates between 8 kN down to 5 kN up. The material for the beam is steel with an yield stress of 294 MPa, endurance strength of 275 MPa and factor of safety is 2.50. Determine the width of rectangular cross section taking surface finish factor as 0.95, size factor on 0.90 and stress concentration factor as 1.65. (10 Marks)

OR

- 4 a. Derive the Soderberg's equation for designing the members subjected to fatigue loading. (06 Marks)
- b. A simply supported beam of span 1000 mm is subjected to a central load of 20 kN that falls from a height of 20 mm. The beam has a rectangular cross section of width 60 mm and depth 200 mm. The material of the beam has a modulus of elasticity of 207 GPa. Determine (i) Impact factor (ii) Instantaneous deflection (iii) Impact load. (10 Marks)

Module-3

- 5 a. Design a socket and spigot type cotter joint to sustain an axial load of 100 kN. The material selected for the joint has the following design stresses $\sigma_t = 80 \text{ N/mm}^2$, $\tau = 60 \text{ N/mm}^2$, $\sigma_c = 150 \text{ N/mm}^2$. (08 Marks)
- b. A cast iron flange coupling is used to connect two shafts of 80 mm diameter. The shaft runs at 250 rpm and transmits a torque of 4300 N-m. The permissible shear stress for bolt material is 50 MPa and permissible shear stress for flange is 8 MPa. Design bolts and the coupling. (08 Marks)

OR

- 6 A shaft mounted between bearings 1.2 m apart receives a power of 20 kW at 1000 rpm through a pulley 600 mm diameter located 400 mm from the left bearing from another pulley directly below it. The power is delivered through a gear of 200 mm diameter located 700 mm from the left bearing to another gear in front of it. The shaft rotates counterclockwise when viewed through the left bearing. The belt has a ratio of tensions of 2.5 and the gear is of 20° pressure angle. Determine the shaft diameter assuming the shaft to be made of steel with an yield shear stress of 180 MPa and factor of safety as 3. Take $K_b = 1.5$, $K_t = 1.0$. (16 Marks)

Module-4

- 7 a. Design a double riveted butt joint with equal width cover plates to join two plates of thickness 10 mm. The allowable stress for plate and rivets are $\sigma_t = 80 \text{ MPa}$, $\tau = 60 \text{ MPa}$ and $\sigma_c = 120 \text{ MPa}$. (08 Marks)
- b. Determine the size of weld required for an eccentrically loaded weld as shown in Fig. Q7 (b). The allowable stress in the weld is 75 MPa. (08 Marks)

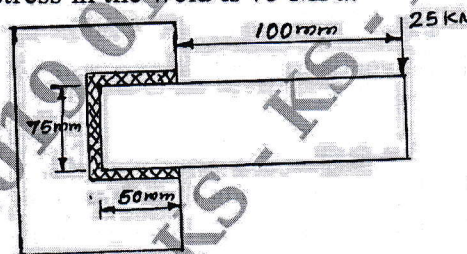


Fig. Q7 (b)

OR

- 8 a. Two lengths of a flat tie bar of 18 mm thick are connected by a butt joint with equal cover plates on either side. If a load of 400 kN is acting on the bar, design the joint such that the section of the bar is not weakened by more than one rivet hole. The working stresses for the material of the bar is 100 MPa in tension, for the material of the rivet 70 MPa in shear and 160 MPa in crushing. (10 Marks)
- b. A plate of 80 mm wide and 15 mm thick is to be joined with another plate by a single transverse weld and a double parallel weld. Determine length of parallel weld if joint is subjected to static loading. Take $\sigma_t = 90 \text{ MPa}$, $\tau = 55 \text{ MPa}$ as allowable stresses and stress concentration factor as 1.5 for transverse weld and 2.7 for parallel weld. (06 Marks)

Module-5

- 9 a. A cylinder head of a steam engine is subjected to a steam pressure of 0.8 MPa. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak proof. The bore diameter of the cylinder is 250 mm. Find the size of bolts so that the stress in bolts is not to exceed 110 MPa. (08 Marks)
- b. The lead screw of a lathe has single start ISO trapezoidal threads of 30 mm outside diameter and 6 mm pitch. It drives a tool carriage and exerts an axial load of 1.5 kN on a thrust collar of 30 mm inside diameter and 50 mm outside diameter. If the lead screw rotates at 40 rpm, find the power required to drive the screw. Take coefficient of friction for power screw as 0.14 and for collar as 0.09. (08 Marks)

OR

- 10 a. Explain the stresses induced in a screw fastening subjected to static and impact loading. (06 Marks)
- b. A power screw for a Jack has square threads of proportion $50 \times 42 \times 8$. The coefficient of friction at the threads is 0.1 and at the collar is 0.12. Determine the weight that can be lifted by this jack through a human effort of 400 N, through a hand lever of span 400 mm. (10 Marks)

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15ME562

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020 Energy and Environment

Time: 3 hrs.

Max. Marks: 80

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

Module-1

- 1 a. Interpret World Energy Scenario with respect to production and consumption using relevant statistics. (08 Marks)
- b. Outline the factors that affect India's energy development. (08 Marks)

OR

- 2 a. Explain the various Key energy trends in India. (10 Marks)
- b. Explain the forms of Energy and differentiate energy and power. (06 Marks)

Module-2

- 3 a. List the various thermal energy storage methods. Explain the working principle of solar pond with neat sketch. (08 Marks)
- b. A thermal power plant of 210MW capacity has the maximum load of 160MW. Its annual load factor is 0.6. The coal consumption is 1kg per kWh of Energy generated and the cost of coal is Rs. 450 per tonne. Calculate (i) The annual revenue earned if energy is sold at Rs 1 per kWh and ii) The capacity factor of the plant. (08 Marks)

OR

- 4 a. Define energy audit, explain the need for energy audit and mention the various phases of energy audit methodology. (08 Marks)
- b. A company owns a premium plot. They have to decide which of several alternatives to select in trying to obtain a desirable return on their investment. After much study and calculation, they decide that the two best alternatives are as given in the following table.

	Build solar power plant	Build Hydro power plant
First cost (Rs.)	20,00,000	36,00,000
Annual property taxes (Rs.)	80,000	1,50,000
Annual Income (Rs.)	8,00,000	9,80,000
Life of land (Years)	20	20
Salvage value (Rs.)	0	0

Evaluate the alternative based on the future worth method at $i = 12\%$. (08 Marks)

Module-3

- 5 a. Explain the following with a neat sketch i) Food chain ii) Food Web iii) Energy pyramid or Ecological pyramid. (06 Marks)
- b. What is an Ecosystem? Explain different types of forest ecosystem. (10 Marks)

OR

- 6 a. Explain grassland ecosystems and its types. (08 Marks)
- b. Write a short notes on : i) Nitrogen cycle ecosystem ii) Oxygen cycle ecosystem iii) Desert ecosystem iv) Aquatic ecosystem. (08 Marks)

Module-4

- 7 a. Discuss briefly the causes, effects and control of Air Pollution. (08 Marks)
b. Discuss briefly the causes, effects and control measures of i) Soil pollution (08 Marks)
ii) Noise pollution iii) Thermal pollution iv) Marine pollution.

OR

- 8 a. Discuss Solid waste management techniques. (08 Marks)
b. Discuss any two case studies related to pollution of environment in detail. (08 Marks)

Module-5

- 9 a. What is acid rain? What are its effects and write a short note on Ozone layer depletion. (08 Marks)
b. Discuss : i) Wildlife Protection Act ii) Forest Conservation Act. (08 Marks)

OR

- 10 a. What are the regulations governing Water Pollution Prevention Act? (08 Marks)
b. Explain the impact of global warming on our mother nature. (08 Marks)
