CBCS SCHEME

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15ME51

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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 interest chart is permitted.

Module-1

1 a. Define management and explain the functions of management. **(08 Marks)**
  b. Explain briefly the contributions of F.W. Taylor for the scientific management. **(08 Marks)**

OR

2 a. Briefly explain the importance of planning. **(08 Marks)**
  b. Briefly explain the important steps in planning. **(08 Marks)**

Module-2

3 a. Briefly explain the principles of organization. **(08 Marks)**
  b. Briefly explain M.B.O and M.B.E with advantages and disadvantages. **(08 Marks)**

OR

4 a. Explain briefly Maslow's theory of motivation. **(08 Marks)**
  b. What is coordination? Explain the importance of coordination. **(08 Marks)**

Module-3

5 a. With a neat sketch, explain problem solving and decision making. **(08 Marks)**
  b. A 45 years old person is planning for his retired life. He plans to invest Rs.30000 every year for the next 15 years. The bank gives 12% interest rate compounded annually. Find the maturity value when he is 60 years old. **(08 Marks)**

OR

6 a. Explain the law of demand and supply with price versus demand/supply graph. **(08 Marks)**
  b. A person takes a loan of Rs.30,00,000 from a nationalized bank to build a new house at an interest rate of 7.5% compounded annually. This amount has to be repaid in 15 years at equal installments. Find the annual installment that the person has to pay to the bank. **(08 Marks)**

Module-4

7 a. Briefly explain the conditions for present worth comparison. **(08 Marks)**
  b. A granite company is planning to by a fully automated granite cutting machine. If it is purchased under down payment, the cost of the machine is Rs.16,00,000. If it is purchased under installment basis the company has to pay 25% of the cost at the time of purchase and the remaining amount in 10 annual equal installments of Rs.2,00,000 each. Suggest the best alternative for the company using the present worth basis at i = 18% compounded annually. **(08 Marks)**

<center>**OR**</center>

8 a. Explain briefly rate of return, MARR, IRR and ERR. **(08 Marks)**
   b. A company is trying to diversify its business in a new product line. The life of the product is 10 years with no salvage value at the end of its life. The initial outlay of the project is Rs.20,00,000. The annual net profit is Rs.3,50,000. Find the rate of return for the new business. **(08 Marks)**

<center>**Module-5**</center>

9 a. Briefly explain the varies elements of cost. **(08 Marks)**
   b. BOSH company produces 500 spark plugs/day, involving direct material cost of Rs.40,000. Direct labour cost of Rs.35,000 and factory overheads of Rs.10000. Assuming a profit of 15% of the selling price and selling overheads to be 30% of the factory cost. Find the selling price of one spark plug. **(08 Marks)**

<center>**OR**</center>

10 a. What is depreciation? Explain the causes of depreciation. **(08 Marks)**
   b. A company has purchased an equipment whose first cost is Rs.1,00,000 with an estimated life of 8 years. The estimated salvage value of the equipment at the end of its life time is Rs.20,000. Find the depreciation and book value for the 5th year using the sum of the years-digits method of depreciation. **(08 Marks)**

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USN ☐☐☐☐☐☐☐☐☐☐ **15ME52**

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Dynamics of Machinery

Time: 3 hrs.   Max. Marks: 80

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

Module-1

1   a.   State the condition for static equilibrium of a body subjected to a system of
         i) two forces   ii) three forces   iii) member with two forces and a torque. **(06 Marks)**
    b.   For the 4 bar mechanism shown in Fig.Q.1(b), find the required torque T_2 and various P in
         forces on the links for the equilibrium of the system. **(10 Marks)**

Fig.Q.1(b)

AD = 215 mm
AB = 200 mm
BC = 370 mm
DC = 350 mm
CE = 100 mm
F = 2000 N
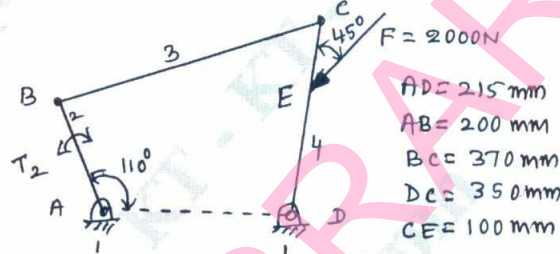
OR

2   a.   Explain D'Almerts principle and state its significance. **(04 Marks)**
    b.   In a vertical double acting steam engine, the connecting rod is 4.5 times the crank. The
         weight of the reciprocating parts is 120kg and the stroke of the Piston is 440mm. The engine
         runs at 250rpm. If the net load on the Piston due to steam pressure is 25kN when the crank
         has turned through an angle of 120° from the top dead centre, determine:
    i)   Thrust in the connecting rod
    ii)   Pressure on slide bars
    iii)   Tangential force on the crank pin
    iv)   Thrust on the bearings
    v)   Turning moment on the crank shaft. **(12 Marks)**

Module-2

3   a.   What do you mean by static and dynamic balancing? **(04 Marks)**
    b.   A, B, C and D are 4 masses carried by a rotating shaft at radii 100, 125, 200 and 150mm
         respectively. The planes in which the masses revolve are spaced 600mm apart and the mass
         of B, C and D are 10kg, 5kg and 4kg respectively. Find the required mass A and the relative
         angular settings of the 4 masses so that the shaft shall be in complete balance. **(12 Marks)**

OR

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

Module-3

5 a. Explain the following terms relative to governors: i) Stability ii) Sensitiveness iii) Isochronism iv) Hunting. **(08 Marks)**

b. A porter governor has equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5kg and the mass of the central load on the sleeve is 15kg. The radius of rotation of the ball is 150mm when the governor begins to lift and 200mm when the governor is at maximum speed. Find the minimum and maximum speeds and the range of speed of the governor. **(08 Marks)**

OR

6 a. With neat sketches, explain the effect of gyroscopic couple on steering, pitching and rolling of a ship. **(06 Marks)**

b. An aeroplane flying at 240km/h turns towards the left and completes a quarter circle of 60m radius. The mass of the rotor engine and the propeller of the plane is 450kg with a radius of gyration of 320mm. The engine speed is 2000 rpm clockwise when viewed from the rear. Determine the gyroscopic couple on the aircraft and its effect. In what way is the effect changed when the

i) Aeroplane turns towards right

ii) Engine rotates clockwise when viewed from the front (nose end) and the aeroplane turns left and right. **(10 Marks)**

Module-4

7 a. Add the following harmonic motions analytically and check the solutions graphically:

$x_1 = 4 \cos (wt + 10°)$

$x_2 = 6 \sin (wt + 60°)$ **(08 Marks)**

b. Find the natural frequency of the system shown in the Fig.Q.7(b) using energy method. **(08 Marks)**

Fig.Q.7(b)

OR

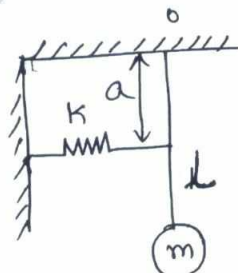8 a. Find the natural frequency of the system shown in Fig.Q.8(a) using Newton's method. **(08 Marks)**

Fig.Q.8(a)

b. Find the natural frequency of the system shown in Fig.Q.8(b), K = 2 × 10⁵ N/m, m = 20kg.
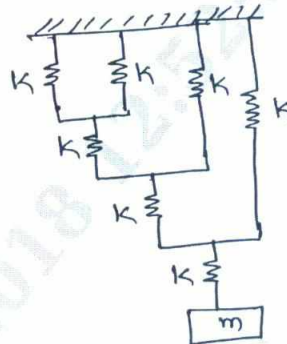
(08 Marks)

Fig.Q.8(b)

Module-5

9 a. Set up the differential equation for a spring mass damper system and obtain complete solution for the critically damped condition. **(08 Marks)**

b. Determine:
   i) Critical damping coefficient
   ii) Damping factor
   iii) Natural frequency of damped vibrations
   iv) Logarithmic decrement
   v) Ratio of two consecutive amplitude of vibrating system which consists of mass of 25kg, a spring of stiffness 15 kN/m and a damper. The damping provided is only 15% of the critical value. **(08 Marks)**

OR

10 a. Define transmissibility and derive an expression for the transmissibility ratio and the phase angle for transmitted force. **(08 Marks)**

b. A machine of mass one ton is acted upon by an external force 2450N at a frequency of 1500rpm. To reduce the effects of vibration, isolator and rubber having a static deflection of 2mm under the machine load and an estimated damping factor of 0.2 are used. Determine :
   i) Force transmitted to the foundation
   ii) Amplitude of vibration of the machine
   iii) Phase lag of the transmitted force with respect to the external force. **(08 Marks)**

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CBCS SCHEME

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Turbomachines

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Differentiate between turbo machines and positive displacement machines. **(08 Marks)**
   b. Test on a turbomachine runner 1.25 m in diameter at 30 m head gave the following results. Power developed = 736 KW. Speed is 180 rpm and discharge 2.7 m³/s. Find the diameter, speed and discharge of a runner to operate at 45 m head and give 1472 KW at the same efficiency. What is specific speed of both the turbines? **(08 Marks)**

OR

2 a. Show that the polytropic efficiency during the expansion process is given by

$$\eta_p = \dfrac{\ln\left[\dfrac{T_2}{T_1}\right]}{\dfrac{\gamma-1}{\gamma}\ln\left[\dfrac{P_2}{P_1}\right]}.$$

(08 Marks)

   b. A stream of combustion gases at the point of entry to a turbine has a static temperature of 1050 K, static pressure of 600 kPa, and a velocity of 150 m/s. For the gases, C_p = 1.004 kJ/kgK and γ = 1.41. Find the total temperature and total pressure of the gases. Also find the difference between their static and total enthalpies. **(08 Marks)**

Module-2

3 a. Derive alternate form of Euler equation and explain each component in that. **(08 Marks)**
   b. In an inward radial flow hydraulic turbine water enters with an absolute velocity of 15 m/s with a nozzle angle of 15°. The speed of the rotor is 400 rpm. Diameter of the rotor at inlet and outlet are 75 cm and 50 cm respectively. The fluid leaves the rotor radially with an absolute velocity of 5 m/s. Determine: (i) The blade angles (ii) work done (iii) utilization factor. **(08 Marks)**

OR

4 a. Derive theoretical head capacity relation in case of radial flow pump [centrifugal]

$$H = u_2^2 - \dfrac{u_2^2 Q \cot\beta_2}{A_2}$$

β_2 = discharge blade angle with respect to tangential direction. Explain the effect of discharge angle on it. **(08 Marks)**

   b. An axial flow compressor has the following data. Entry conditions: 1 bar and 20°C, degree of reaction = 50%, mean blade ring dia = 60 cm, rotational speed = 18000 rpm, blade angle at rotor and stator exit = 65°. Axial velocity = 180 m/s, mechanical efficiency = 96.7%. Find:
   i) Blade angle at rotor and stator inlet.
   ii) Power required to derive the compressor. **(08 Marks)**

Module-3

5 a. What is compounding? Explain any two methods of compounding. **(08 Marks)**

   b. The following particulars refer to a single impulse turbine. Mean diameter of blade ring = 2.5 m, speed = 3000 rpm, nozzle angle = 20°, ratio of blade velocity to steam = 0.4, blade friction factor = 0.8, blade angle at exit is 3° less than that at inlet. Steam flow rate 36000 kg/hr. Draw the velocity diagram and calculate (i) power developed (ii) blade efficiency. **(08 Marks)**

OR

6 a. Derive the condition for maximum efficiency of reaction steam turbine and hence prove that

$$\eta_{b\,max} = \frac{2\cos^2\alpha_1}{1+\cos^2\alpha_1}.$$

(08 Marks)

   b. A Parson's turbine is running at 1200 rpm. The mean rotor diameter is 1m. Blade outlet angle is 23°, speed ratio is 0.75. Stage efficiency is 0.8. Find enthalpy drop in this stage. **(08 Marks)**

Module-4

7 a. Show that for maximum efficiency of pelton wheel the bucket velocity is equal to half of the jet velocity $U = \dfrac{V_1}{2}$. **(08 Marks)**

   b. In a power station, a pelton wheel producer 15000 KW under a head of 350 m, while running at 500 rpm. Assume a turbine efficiency of 0.84, coefficient of velocity for nozzle as 0.98, speed ratio 0.46 and bucket velocity coefficient 0.86. Calculate: (i) Number of jet (ii) Diameter of each jet (iii) Tangential force on the buckets if the bucket deflect the jet through 165°. **(08 Marks)**

OR

8 a. With a mathematical expression, define the following:
    i) Hydraulic efficiency   ii) Mechanical efficiency
    iii) Overall efficiency   iv) Volumetric efficiency   **(08 Marks)**

   b. A Kaplan turbine working under a head of 20 m develops 11772 KW shaft power. The outer diameter of the runner is 3.5 m and hub dice is 1.75 m. The guide blade angle at the extreme edge of the runner is 35°. The hydraulic and overall efficiency of the turbine are 88% and 84% respectively. If the velocity of whirl is zero at outlet, determine:
    i) Runner vane angles at inlet and outlet at the extreme edge of the runner
    ii) Speed of the turbine. **(08 Marks)**

Module-5

9 a. Define the following:
    i) Suction head   ii) Delivery head
    iii) Manometric head   iv) Net positive suction head   **(08 Marks)**

   b. A centrifugal pump working in a dock, pumps 1565 ℓ/s, against head (mean lift) of 6.1 m when the impeller rotates at 200 rpm. The impeller diameter is 122 cm and the area at outlet periphery is 6450 cm². If the vanes are set back at an angle of 26° at the outlet, find (i) hydraulic efficiency (ii) power required to drive the pump. If the ratio of external to internal diameter is 2, find the minimum speed to start pumping. **(08 Marks)**

OR

10 a. For axial flow compressor show that $E = v_f u \left[\dfrac{\tan\beta_2 - \tan\beta_1}{\tan\beta_1 \tan\beta_2} \right]$. **(08 Marks)**

   b. What are the types of diffuses used in centrifugal compressor? Explain any two. **(08 Marks)**

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Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Design of Machine Elements – I

Time: 3 hrs.

Max. Marks: 80

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

Module-1

1 a. List the factors which govern the selection of appropriate material for a machine component.
(05 Marks)

   b. A stepped shaft with its diameter reduced for '2d' to 'd' has a fillet radius of 0.1d. Determine the diameters of the shaft and the radius of the fillet to transmit a power of 65 KW at a rated speed of 1440 rpm limiting the shear stress induced to 60 MPa. (11 Marks)

OR

2 a. Define stress concentration and show how stress concentration can be reduced for two examples with neat sketches. (06 Marks)

   b. A cantilever beam of rectangular cross section with a depth of 150 mm is subjected to an axial tensile load of 40 kN and a transverse load of 50 kN acting downwards at the free end of 600 mm length beam. The material of the beam has allowable tensile stress of 100 MPa. Determine the width of rectangular section of the beam. (10 Marks)

Module-2

3 a. Derive an expression for impact stress induced in a member subjected to axial load.
(06 Marks)

   b. A piston rod of steam engine is subjected to a completely reversed axial load of 50 kN. The material of rod has an yield normal stress of 310 N/mm^2 and endurance stress of 289 N/mm^2. Assuming load factor of 0.7, size factor as 1 and surface finish factor as 1. Determine the diameter of rod. Choose factor of safety as 2. (10 Marks)

OR

4 a. Derive Soderberg's relation for a member subjected to fatigue loading. (06 Marks)

   b. A beam of 400 mm depth I-section is resting on two supports 5m apart. It is loaded by a weight of 8 kN falling through a height of 20 mm and striking the beam at mid point. Moment of inertial of the section is 12×10^7 mm^4. Take E = 2×10^5 N/mm^2. Determine:
   i) Impact factor
   ii) Instantaneous maximum stress
   iii) Instantaneous maximum deflection
   iv) Instantaneous maximum load. (10 Marks)

Module-3

5 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 pinion of 200 mm diameter located 700 mm from the left bearing to another gear in front of it. The shaft rotates clockwise when viewed through the left bearing. The belt has a ratio of tensions of 2.5 and the gears are of 20° pressure angle. The weight of the pulley is 500 N and that of the gear is 200 N. Determine the diameter of shaft. The material of the shaft has design shear stress of 60 MPa. Choose $K_b = 1.5$, $K_t = 1.0$. (16 Marks)

OR

6 a. Design a cotter joint to join two round rods capable of sustaining an axial load of 100 kN. The material of the joint has design tensile stress = 100 N/mm^2, crushing stress = 150 N/mm^2 and shear stress = 60 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 2500 N-m. The permissible shear stress for shaft material and bolt materials is 50 MPa and permissible shear stress for flange is 20 MPa. Design the bolts and the flange. Also select suitable key for the coupling. Take allowable normal stress for bolt as 100 MPa. **(08 Marks)**

Module-4

7 a. Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm^2. Assume an efficiency of 72%, allowable tensile stress in the plate of 90 N/mm^2, crushing stress of 140 N/mm^2 and an allowable shear stress in the rivet of 50 N/mm^2. **(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.
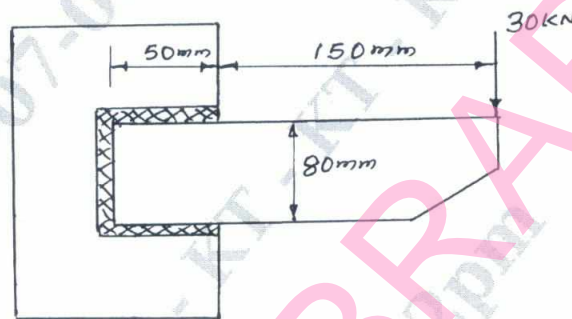

Fig.Q7(b) **(08 Marks)**

OR

8 a. Two lengths of a flat tie bar for a bridge structure of 250 mm wide and 18 mm thick are connected by a diamond joint with equal cover plates on either side. Design the joint completely working stresses for the material of the bar are 100 MPa in tension, 70 MPa in shear and 160 MPa in crushing. **(08 Marks)**

b. One end of a rectangular bar of cross section 120 mm × 70 mm is welded to a vertical support by four fillet welds along its circumference. A steady transverse load of 10 kN is applied at the free end of the bar of length 160 mm and is parallel to 120 mm side. Determine the size of weld, if the allowable stress in the material is limited to 115 MPa. **(08 Marks)**

Module-5

9 a. A bracket is fixed to the wall by means of four bolts and loaded as shown in Fig.Q9(a). Calculate the size of bolts if the load is 10 kN and allowable shear stress in the bolt material is 40 MPa.
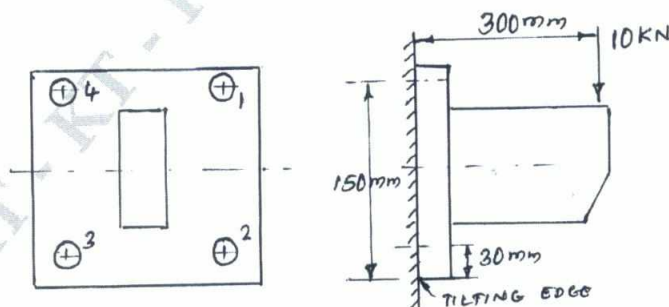

Fig.Q9(a) **(08 Marks)**

b. A square threaded power screw has a nominal diameter of 30 mm and a pitch of 6 mm with double threads. The load on the screw is 6 kN and the mean diameter of the thrust collar is 40 mm. the coefficient of friction for the screw is 0.1 and the collar is 0.09. Determine:
   i) Torque required to raise and lower the screw with load
   ii) Overall efficiency (08 Marks)

OR

10 A screw jack is to lift a load of 80 kN through a height of 400 mm ultimate strength of screw material in tension and compression is 200 N/mm² and in shear 120 N/mm². The material for the nut is phosphor bronze for which the ultimate strength is 100 N/mm² in tension and 90 N/mm² in compression and 80 N/mm² in shear. The bearing pressure between the nut and the screw is not to exceed 18 N/mm². Design the screw and nut and check for stresses. Take FOS = 2, μ = 0.14. Design jack for 25% overload. (16 Marks)

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Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Non Traditional Machining

Time: 3 hrs.   Max. Marks: 80

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

Module-1

1 a. How do you classify Non-traditional machining processes? Discuss briefly.   (08 Marks)
   b. Compare the traditional and non-traditional machining processes.   (08 Marks)

OR

2 a. Explain the need for non-traditional machining processes.   (08 Marks)
   b. Write in brief note on the selection of non traditional machining processes. (08 Marks)

Module-2

3 a. With a neat sketch, explain the working principle and operation of USM process. (08 Marks)
   b. Discuss the influence of the following parameters on USM process:
          (i)   Amplitude and frequency of vibration.
          (ii)   Abrasive grain size.
          (iii) Effect of slurry.
          (iv) Applied static load.   (08 Marks)

OR

4 a. Explain the process variables that influence the metal removal rate in abrasive jet machining.   (08 Marks)
   b. Mention any two advantages, disadvantages and applications of water jet machining process.   (08 Marks)

Module-3

5 a. Briefly explain the electrolytes used in ECM process.   (08 Marks)
   b. With a schematic diagram, explain the Electro Chemical Honing process.   (08 Marks)

OR

6 a. List out the various process parameters and briefly explain their effects on chemical machining process.   (08 Marks)
   b. Write a short note on chemical blanking.   (08 Marks)

Module-4

7 a. With a neat sketch, briefly explain the Feed control in EDM process.   (08 Marks)
   b. What are the requirements of Dielectric fluid? Mention any two dielectric fluids used in EDM process.   (08 Marks)

OR

8 a. With a neat sketch, briefly explain PAM process.   (08 Marks)
   b. Discuss some of the important considerations in the design of plasma Torch in PAM.   (08 Marks)

Module-5

9 a. With a neat sketch, briefly explain the principle and working of laser beam machining.   (08 Marks)
   b. What are the advantages and limitations of LBM process?   (08 Marks)

OR

10 a. With a neat sketch, briefly explain working of electron beam machining.   (08 Marks)
    b. Write the applications and limitations of Electron Beam Machining (EBM).   (08 Marks)

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ 15ME562

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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. List and explain the different forms of energy. (06 Marks)
 b. Explain briefly the key energy trends in India. (10 Marks)

OR

2 a. Discuss briefly the demand and consumption of coal in India. (06 Marks)
 b. Explain briefly the factors affecting India's energy development. (10 Marks)

Module-2

3 a. Explain the following with one example : (08 Marks)
 i) Sensible heat thermal storage system ii) Latent heat thermal storage system.
 b. Discuss the energy conservation schemes. (08 Marks)

OR

4 a. What is Energy audit and its objectives? (08 Marks)
 b. Discuss the steps to be followed in undertaking preliminary energy audit in an industrial company. (08 Marks)

Module-3

5 a. Explain with a suitable examples, multidisciplinary nature of environmental studies.
 (10 Marks)
 b. Discuss the need for public awareness of environment management. (06 Marks)

OR

6 a. Explain the flow of energy through the various components of the eco system. [Producers, Consumers and Decomposers]. (08 Marks)
 b. Explain the concept of ecological pyramids and food chains. (08 Marks)

Module-4

7 a. Discuss the major sources and effects of air pollution. (08 Marks)
 b. Define Noise pollution. List the major sources and effects of noise pollution. (08 Marks)

OR

8 a. With a neat diagram, explain Municipal Solid Waste [MSW] Processing unit. (10 Marks)
 b. Discuss the role of individual in pollution prevention. (06 Marks)

Module-5

9 a. Explain the phenomenon of global warming, factor contributing global warming and its effect. (10 Marks)
 b. What is Acid rain? Explain the causes and effects of acid rain. (06 Marks)

OR

10 a. Write short notes on : (10 Marks)
 i) The water [Prevention and control of pollution] Act ii) Environment Protection Act.
 b. Explain how ozone layer depletion occurs. Discuss the impact of ozone depletion on human health. (06 Marks)

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CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

15ME563

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Automation and Robotics

Time: 3 hrs.

Max. Marks: 80

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

Module-1

1   a. Briefly explain the different types of automation. **(08 Marks)**
    b. Write short notes on: i) Reasons for automation   ii) Disadvantages of Automation. **(08 Marks)**

OR

2   a. Define FMS and list out the benefits of FMS. **(06 Marks)**
    b. Briefly explain the various components of FMS. **(10 Marks)**

Module-2

3   a. Define a Robot and state Asimov's laws for robotics. **(04 Marks)**
    b. Discuss robot anatomy and sketch the following robot configuration:
       i)   Polar configuration   ii) Jointed arm configuration. **(12 Marks)**

OR

4   a. With respect to precision of movement, define the following terms:
       i)   Spatial resolution   ii) Accuracy   iii) Repeatability. **(06 Marks)**
    b. Briefly explain the different types of joints used in robots. **(10 Marks)**

Module-3

5   Derive a mathematical model for a spring-mass damper system and draw the block diagram for the same. Also reduce it to a single block using block diagram algebra. **(16 Marks)**

OR

6   a. Write short notes on resolvers and encoders. **(10 Marks)**
    b. At time t, the excitation voltage to a resolver is 24V. The shaft angle is 90°. What is the output signal from resolver? Also if $V_{s_1} = 17V$ and $V_{s_2} = -17V$, calculate the angle. **(06 Marks)**

Module-4

7   a. Briefly discuss about the tactile sensors used in robotics. **(12 Marks)**
    b. List out the application of sensors in robotics. **(04 Marks)**

OR

8   a. Explain various illumination techniques used in machine vision. **(06 Marks)**
    b. Discuss the various segmentation techniques used in Image Processing. **(10 Marks)**

Module-5

9   a. Discuss the necessary parameters that can be used to assess the performance of a future robot. **(10 Marks)**
    b. Write short note son Telepresence. **(06 Marks)**

OR

10 a. Briefly discuss the goals of AI research. **(10 Marks)**
    b. List out the various search techniques in problem solving. **(06 Marks)**

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