CBCS SCHEME

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17ME61

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Finite Element Analysis

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the steps involved in Finite Element Analysis, list with neat sketches, the types of elements in FEA. **(10 Marks)**

b. Determine the nodal displacements for the spring mass system shown in the Fig. Q1(b) by using the principle of minimum potential energy. Take $F_1 = 75N$ and $F_2 = 100N$

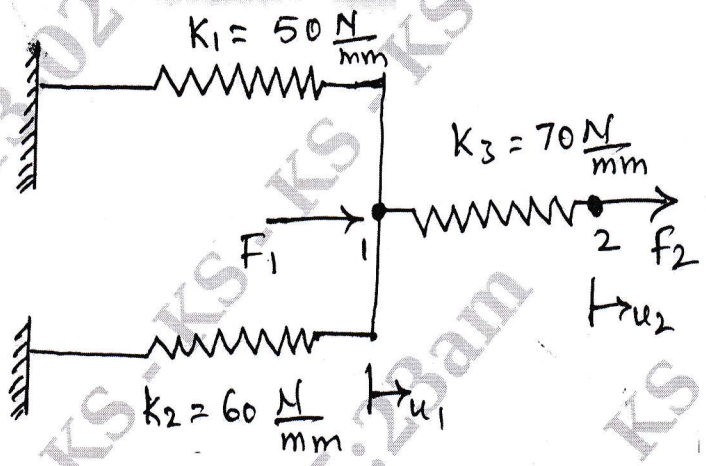


Fig Q1(b) **(10 Marks)**

OR

2 a. Explain : i) Plane stress and plane strain with neat sketch ii) Phases in FEA. **(10 Marks)**

b. Determine the displacement at midpoint and stress in the linear 1 – D rod shown in the Fig Q2(b). Use second degree polynomial approximation.

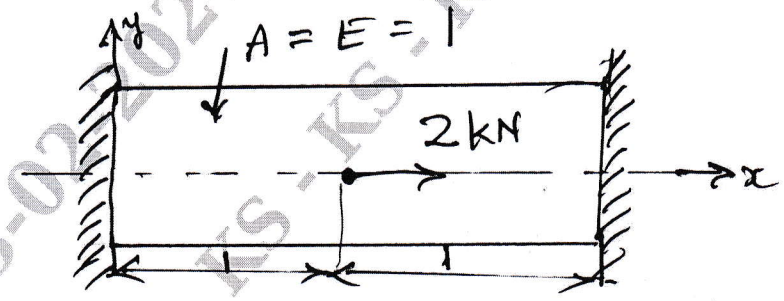
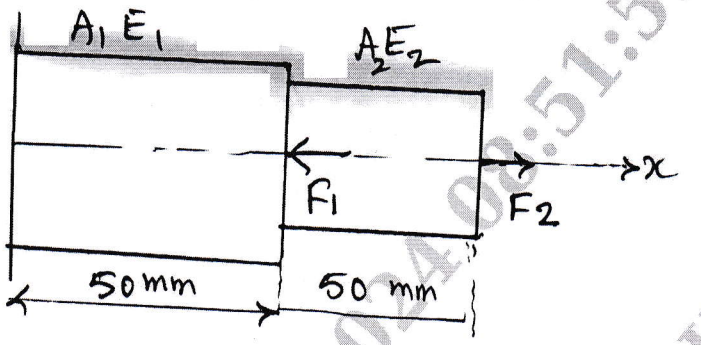


Fig Q2(b) **(10 Marks)**

Module-2

3 a. Derive the stiffness matrix for 1-D linear bar element. Also write the properties of stiffness matrix. **(10 Marks)**

b. Determine the nodal displacement for the stepped bar shown in the Fig Q3(b)



$E_1 = 200GPa$ $E_2 = 70GPA$
$A_1 = 150mm^2$, $A_2 = 100mm^2$
$F_1 = 10kN$, $F_2 = 5kN$

Fig Q3(b)

(10 Marks)

OR

4 a. Derive the shape function for 2-D constant strain Triangular element in Natural co-ordinates. **(10 Marks)**

b. For 2 bar Truss shown in the Fig Q4(b), determine the nodal displacement and stress in element 1. Take $E = 2 \times 10^5$ N/mm^2, $A = 200mm^2$

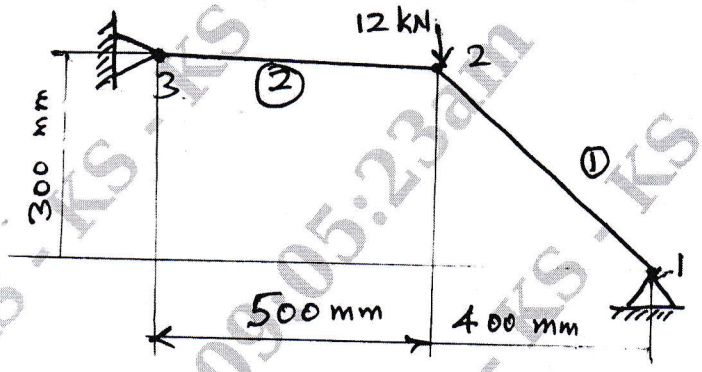
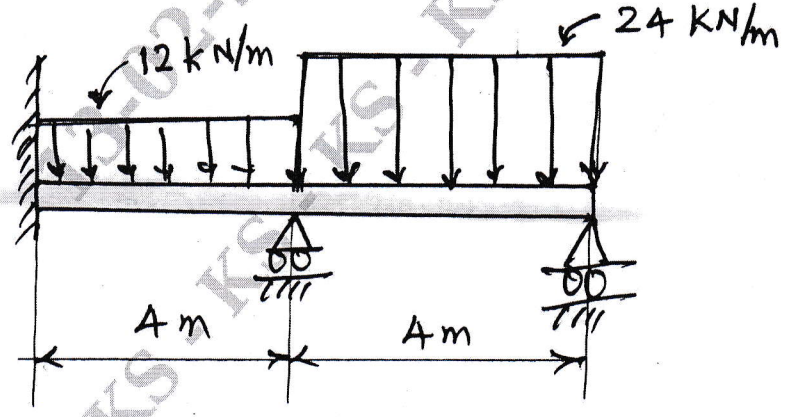


Fig Q4(b) **(10 Marks)**

Module-3

5 a. Derive Hermite shape functions for beam element. **(10 Marks)**

b. For the beam shown in the Fig Q5(b), determine the nodal deflections.



E = 200GPA
$I = 4 \times 10^6 mm^4$

Fig Q5(b)

(10 Marks)

OR

6 a. Derive the stiffness matrix for the 1 – D shaft elements. **(10 Marks)**

b. Determine the deflections for the beam shown in the Fig Q6(b). Take $E = 7 \times 10^9 N/m^2$, $I = 4 \times 10^{-4} m^4$

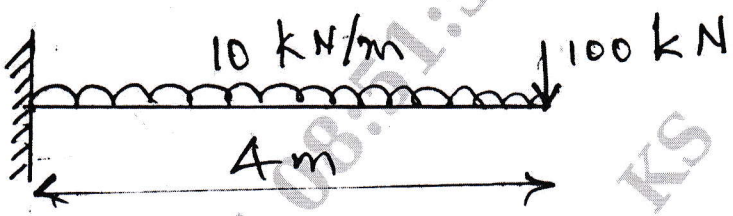
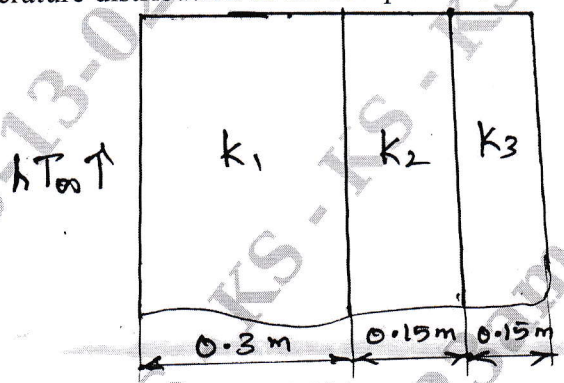


Fig Q6(b) **(10 Marks)**

Module-4

7 a. Derive the differential equation for 1 – D Heat conduction. Also write the rate equation for conduction and convection. **(10 Marks)**

b. Solve for temperature distribution in the composite wall shown in the Fig Q7(b).



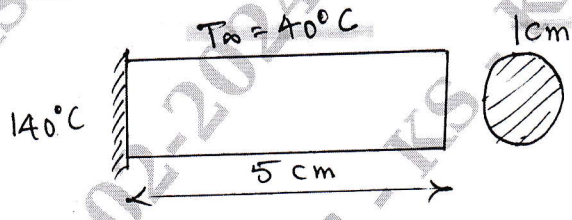
$K_1 = 20$ W/m°C
$K_2 = 30$ W/m°C
$K_3 = 50$ W/m°C
$T_\infty = 800$°C
$h = 25$ W/m^{2}C

Fig Q7(b) **(10 Marks)**

OR

8 a. Explain the types of boundary conditions in 1 – D heat transfer. Write the expressions for 1 – D heat conduction with convention and internal heat generation. **(10 Marks)**

b. Determine the temperature in the 1 – D Fin shown in the Fig Q8(b). Take two elements for FE idealization.



$h = 5$ W/cm^2 – K
$K = 70$ W/cm – K

Fig Q8(b) **(10 Marks)**

Module-5

9 a. Derive shape function for axisymmetric triangular element. **(10 Marks)**

b. Differentiate between static and dynamic analysis with detailed explanation. **(10 Marks)**

OR

10 a. Derive stiffness matrix for Axisymmetric triangular element. **(10 Marks)**

b. Derive lumped mass and consistent mass for a bar element. **(10 Marks)**

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17ME62

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Computer Integrated Manufacturing

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Automation. List and explain different types of Automation. **(08 Marks)**

b. The average part produced in a certain batch manufacturing plant must be processed through an average of 8 machines. There are 15 new batches of parts launched each week. Other pertinent data is as follows : Average operation time is 8 minutes , Average setup time is 280 minutes , Average batch size is 22 units and Average non operation time per batch is 580 minutes. There are 16 machines in the plant. The plant operated on an average of 60 production hours per week. Determine i) Manufacturing lead time ii) Plant capacity iii) Plant utilization. **(12 Marks)**

OR

2 a. Define Buffer storage. Differentiate between Upper bound and Lower bound approach to analyze automate flow lines without storage buffers. **(08 Marks)**

b. The ideal cycle time of an 18 station transfer line is 1.6m. The average time per line will be 8 min and the probability of breaks downs per cycle is equal for all cycles and is equal to 0.006. Determine production rate and line efficiency by considering bound and lower bound approaches. **(08 Marks)**

c. With a neat sketch, explain Synchronous transport system. **(04 Marks)**

Module-2

3 a. What is Computer Aided Design process? Explain with a neat sketch the software configuration of a graphics system. **(08 Marks)**

b. A square with an edge length of 08 units is located on the origin with one of the edge at an angle of 30° with positive X – axis. Calculate the new position of the square if it is rotated about Z – axis by an angle of 30° in clockwise direction. **(08 Marks)**

c. List the different functions of a graphics package. **(04 Marks)**

OR

4 a. Explain Generative type CAPP system with the help of a block diagram. **(08 Marks)**

b. What is Material Requirement Planning? Explain the structure of MRP system. **(08 Marks)**

c. List the advantages of Material Requirement Planning. **(04 Marks)**

Module-3

5 a. What is Group Technology? Enumerate the advantages of Group Technology. **(08 Marks)**

b. Explain various components of FMS with a neat block diagram. **(08 Marks)**

c. List the advantages of Flexible Manufacturing System. **(04 Marks)**

OR

6 a. Explain the following terms in Line Balancing :
i) Minimum Rational work element ii) Precedence diagram iii) Cycle time
iv) Balance delay. **(08 Marks)**

b. In a plant a product is to be assembled as per the following data :

Element	1	2	3	4	5	6	7	8	9	10
Te (min)	6	4	9	3	2	7	5	6	4	7
Preceded by	-	1	1	2	2	3	4, 5	3, 5	7, 8	6, 9

i) Construct precedence.
ii) If the cycle time is 12min, find the number of stations required.
iii) Compute the balance delay of the line using largest candidate rule. **(12 Marks)**

Module-4

7 a. Explain the advantages and disadvantages of CNC machines. **(08 Marks)**

b. Write the part program to turn the profile of the part as shown in Fig. Q7(b). **(08 Marks)**

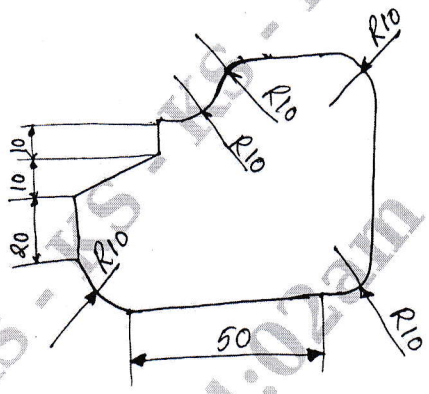

Fig. Q7(b)

c. Explain the Co-ordinate systems in NC/CNC system. **(04 Marks)**

OR

8 a. Explain Robot Anatomy with neat sketch. **(08 Marks)**

b. Explain briefly Resolution , Accuracy and Repeatability as applied to Robots. **(08 Marks)**

c. List the advantages of Robots. **(04 Marks)**

Module-5

9 a. Define Additive Manufacturing Technology and explain various stages of Additive Manufacturing process. **(08 Marks)**

b. List the advantages Additive Manufacturing Process. **(04 Marks)**

c. Explain with a neat sketch, Material Extrusion Process. **(08 Marks)**

OR

10 a. Define I.O.T. Explain the applications of I.O.T in Manufacturing. **(08 Marks)**

b. What are the components of Industry 4.0? Explain. **(08 Marks)**

c. List any five advantages of INDUSTRY 4.0. **(04 Marks)**

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17ME63

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note:* 1. *Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of heat transfer data handbook and steam table are permitted.

Module-1

1 a. Derive the general three dimensional heat conduction equation in Cartesian coordinates. **(10 Marks)**

b. A wall of furnace is made up of silica brick 120 mm thick is covered with a layer of magnesite brick 240 mm thick. The temperature at the inside surface of silica brick wall and outside surface of magnesite brick wall are 725°C and 110°C respectively. The contact thermal resistance between the interface of the two walls is 0.0035 °C/W per unit wall area. If the thermal conductivities of silica and magnesite are 1.7 W/m°C and 5.8 W/m°C. Calculate: (i) The rate of heat loss per unit area (ii) The temperature drop at the interface. **(10 Marks)**

OR

2 a. Explain the boundary conditions of I, II and III kinds used in heat conduction problems. **(10 Marks)**

b. An interior wall of a house may be approximated by a 0.1 m layer of common brick (K = 0.7 W/m°C) followed by a 0.04 m layer of gypsum plaster (K = 0.48 W/m°C). What is the thickness of loosely packed rock wool insulation (K = 0.065 W/m°C) added to reduce the heat loss through the wall by 80%. **(10 Marks)**

Module-2

3 a. Define critical thickness of insulation and also derive the equation of critical radius of insulation for the cylinder. **(10 Marks)**

b. Derive the expression for temperature distribution and rate of heat transfer for infinitely long fin. **(10 Marks)**

OR

4 a. What is lumped heat capacity system? Also derive the expression for lumped heat capacity relating temperature distribution with Biot number and Fourier number. **(10 Marks)**

b. A 12 cm diameter long bar initially at uniform temperature of 40°C is suddenly placed in a medium at 650°C with convective heat transfer coefficient of 22 W/m^{2}K. Calculate the time required to reach the body temperature of 255°C. Take thermal conductivity K = 20 W/m°C, P = 580 kg/m^3, C_p = 1050 J/kg°C. Also calculate the temperature of the body after 7 minutes. **(10 Marks)**

Module-3

5 a. Define the following and write down their significance:
(i) Reynold's Number (ii) Prandtl Number (iii) Biot Number
(iv) Euler Number (v) Grashof Number **(10 Marks)**

b. Using the Buckingham's theorem of dimensional analysis for natural (free) convection, show that Nu = f(Gr, Pr). **(10 Marks)**

OR

6 a. Sketch and explain the following:
(i) Velocity boundary layer
(ii) Thermal boundary layer **(10 Marks)**

b. Hot fluid at 300°C flows through a horizontal pipe of 30 cm outside diameter and 90 cm long. The pipe is exposed to an atmospheric air at 20°C. Determine the rate of natural flow of heat transfer. **(10 Marks)**

Module-4

7 a. Define the following with respect to radiation:
(i) Emissivity (ii) Absorptivity (iii) Reflectivity
(iv) Black body (v) Opaque body **(05 Marks)**

b. State and prove Kirchoff's law of radiation. **(05 Marks)**

c. Establish the relationship between emissive power (E) and intensity of radiation (I). **(10 Marks)**

OR

8 a. What do you mean by radiation shields? Write down their importance in the radiation heat transfer. **(08 Marks)**

b. Two large parallel plates with emissivity 0.4 each are maintained at different temperatures of 727 K and 527 K respectively. If a single equally large radiation shield of emissivity of 0.04 is placed between them. Find the percentage reduction in radiative heat transfer. Take surface area as unity. **(12 Marks)**

Module-5

9 a. Derive the expression for LMTD for parallel flow heat exchanger. **(10 Marks)**

b. The flow rate of hot and cold water streams running through parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperature of hot water and cold water are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the convective heat transfer coefficients on both the sides are 650 W/m^2°C. Calculate the length of the tube in heat exchanger. Take inner and outer diameter of the tube as 2.1 cm and 2.5 cm respectively. Assume K = 400 W/m°C for tube and specific heat of water C_p = 4180 J/kg°C for both hot and cold water. Assume no fouling factors. **(10 Marks)**

OR

10 a. Sketch and explain the regimes of boiling. **(10 Marks)**

b. A vertical plate 30 × 30 cm is exposed to steam at atmospheric pressure. The plate temperature is 98°C. Calculate the heat transfer and mass of steam condensed per hour. **(10 Marks)**

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17ME64

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Design of Machine Elements - II

Time: 3 hrs. Max. Marks: 100

Note : 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Design data hand book is permitted.***

Module-1

1 a. Mention the differences between Straight Beam and Curved Beam. **(04 Marks)**

b. The cross section of steel crane hook is trapezium with a inner side of 50 mm and outer side of 25 mm. The depth of the section is 64 mm. The centre of curvature of the section is at a distance of 64 mm from the inner edge of the section and the line of action of load is 50 mm the same edge. Determine the maximum load the hook carry, if the allowable stress is limited to 600 MPa. **(16 Marks)**

OR

2 a. A cast iron cylinder of internal diameter 200 mm and thickness 50 mm is subjected to a pressure of 5 N/mm^2. Calculate the tangential and radial stresses at the inner, middle and outer surface. **(15 Marks)**

b. A cast steel cylinder of 300 mm internal diameter is to contain a liquid at a pressure of 12.5 N/mm^2. It is closed at both ends by unstayed flat cover plates rigidly bolted to the shell flange. Determine the thickness of the cover plate, if allowable working stress for the cover material is 75 N/mm^2. **(05 Marks)**

Module-2

3 a. Explain modes of failure for chain and lubrication of chains. **(06 Marks)**

b. A nylon core flat belt 200mm wide weighing 20N/m connecting a 300mm diameter pulley to a 900mm diameter driven pulley at a shaft spacing of 6 meter, transmits 55.2 kW at a belt speed of 25m/sec.

i) Calculate the belt length and angles of wrap.

ii) Compute the belt tensions based on a coefficient of frication 0.38. **(14 Marks)**

OR

4 a. Derive the stress in helical springs of circular wire. **(08 Marks)**

b. A load of 2000N is dropped axially on a closed coiled helical spring from a height of 250mm. The spring has 20 effective turns and it is made of 25mm diameter wine. Find the maximum shear stress produced in spring and amount of compression produced. Take C = 8 and G = 84GPa. **(12 Marks)**

Module-3

5 a. Derive an expression for forces acting on Helical gear tooth. **(05 Marks)**

b. A pair of carefully cut spur gears with 20° FDI profile is used to transmit 12 kW at 1200 rpm of pinion. The gear has to rotate at 300 rpm. The material used for both pinion and gear is medium carbon steel whose allowable bending stress may be taken as 230 MPa. Determine the module and face width of the spur pinion and gear. Suggest suitable hardness. Take 24 teeth on pinion. Modulus of elasticity may be taken as 210 GPa. **(15 Marks)**

OR

6 a. Explain briefly the formative number of teeth of bevel gears. **(05 Marks)**

b. Design a pair of bevel gears to transmit 12 kW at 300 rpm of the gear and 1470 rpm of the pinion. The angle between the shaft axes is 90°. The pinion has 20 teeth and the material for gears is cast steel. (σ_0 = 183.33 N/mm^2, BHN 320). Take service factor as 1.25 and check the gears for wear and dynamic load. Suggest suitable surface hardness for the gear pair. Assume tooth form is 20° FDI. **(15 Marks)**

Module-4

7 Design a worm drive for a speed reducer to transmit 30 KW at a worm speed of 600 rpm. The required velocity is 25:1. The worm is made of C30 heat treated steel and worm wheel is made of phosphor bronze. The service conditions are intermittent operations with medium shock loads. Also calculate the heat dissipation through the drive. **(20 Marks)**

OR

8 a. A single plate friction clutch of both sides effective has 0.3 m outer diameter and 0.16 m inner diameter. The coefficient of friction is 0.2 and it runs at 1000 rpm. Find the power transmitted for uniform wear and uniform pressure distribution cases. If the allowable maximum pressure is 0.08 MPa. **(10 Marks)**

b. A single block brake with a torque capacity of 250 N-m is shown in Fig.Q8(b). The brake drum rotates at 100 rpm and the coefficient of friction is 0.35. Calculate :

i) The actuating force and the hinge pin reaction.

ii) The rate of heat generated during the braking action.

iii) Dimensions of the block, if the intensity of pressure between the block and brake drum is 1 MPa. The length of block is twice the width. **(10 Marks)**

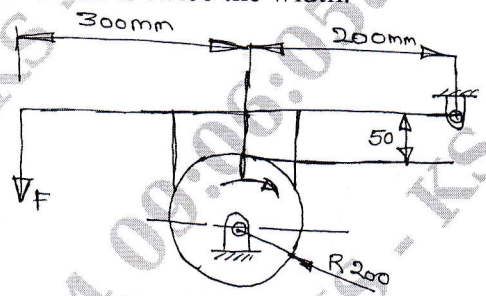

Fig. Q8(b)

Module-5

9 a. What is the purpose of lubrication? Explain the mechanism of hydrodynamic lubrication in journal bearing. **(08 Marks)**

b. Design the main bearing for a stationary slow speed steam engine for the following data : Journal diameter = 200 mm ; Maximum load on the piston = 80 kN Engine speed = 200 rpm. **(12 Marks)**

OR

10 a. A single row deep groove ball bearing has a specific dynamic capacity of 46.3 kN. The actual radial load F_r = 9 kN. The speed of rotation is 1800 rpm. What is the life in i) Cycles of operation ii) In hours iii) What is the average life? **(08 Marks)**

b. Design a multi collar thrust bearing for a propeller shaft of a 400 kW marine oil engine. The engine makes 300 rpm. The propeller has a pitch of 2.5 m and slip is 30%. The permissible bearing pressure is 0.5 N/mm^2. Assume uniform pressure theory. **(12 Marks)**

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17ME655

Sixth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Automobile Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. With neat sketches explain the various methods of cylinder arrangements used in multi-cylinder engine. **(08 Marks)**

b. What is swirl? List out the various methods of swirl generation. **(04 Marks)**

c. With a neat sketch explain pressure forced feed lubrication. **(08 Marks)**

OR

2 a. With a neat sketches explain the different methods of connecting gudgeon pin with piston and connecting rod. **(08 Marks)**

b. List out the comparison between wet and dry liners. **(04 Marks)**

c. With a neat sketch explain the pump circulation system of water coaling in IC engines. **(08 Marks)**

Module-2

3 a. Explain the construction and working of multi-plate clutch with a neat sketch. **(10 Marks)**

b. With a neat sketch, explain the principle of operation of Differential. **(10 Marks)**

OR

4 a. With a neat sketch explain the synchromesh gear box. **(10 Marks)**

b. Explain the working of hydraulic braking system with a neat sketch. **(10 Marks)**

Module-3

5 a. With a neat sketch, explain the working principle of Battery Ignition System **(10 Marks)**

b. With neat representations on diagram explain :
i) Caster ii) Camber ii) Scrub Radius
iii) King Pin Angle iv) Toe in and inclination. **(10 Marks)**

OR

6 a. With a neat sketch explain the air suspension system. **(10 Marks)**

b. Explain the working of Torsion bar suspension with a neat sketch. **(10 Marks)**

Module-4

7 a. Explain the construction and principle of working of Zenith Carburetor. **(10 Marks)**

b. Explain the normal and abnormal combustion processes with relevant sketches. **(10 Marks)**

OR

8	a.	Explain the methods of super charging with neat sketches.	**(10 Marks)**
	b.	Explain the construction and working of turbo charger with a neat sketch.	**(10 Marks)**

Module-5

9	a.	With a neat sketch explain the controlling crank case emissions.	**(10 Marks)**
	b.	With a neat sketch explain the air injection system to reduce the emissions.	**(10 Marks)**

OR

10	a.	With a neat sketch explain the working of Exhaust gas Recirculation system.	**(10 Marks)**
	b.	With a neat sketch explain the Catalytic converter.	**(10 Marks)**

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