

# ME V SEM

Techno India NJR Institute of Technology

Plot-SPLT, Bhamashah (RIICO) Industrial Area  
Kaladwas, Udaipur-313003 (Rajasthan)

Total No. of Pages: 2

5E1718

Roll No. \_\_\_\_\_

5E1718

B. Tech. V - Sem. (Main) Exam., February - 2023

Automobile Engineering

5AE3 – 01 Mechatronic Systems

AE, ME

Time: 3 Hours

Maximum Marks: 70

*Instructions to Candidates:*

*Attempt all ten questions from Part A, five questions out of seven questions from Part B and three questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination.  
(Mentioned in form No. 205)*

1. NIL

2. NIL

## PART – A

(Answer should be given up to 25 words only)

[10×2=20]

All questions are compulsory

- Q.1 What do you mean by Mechatronic systems?
- Q.2 What are the basic functions of control system?
- Q.3 Differentiate between LTV and LTI systems.
- Q.4 Explain the dynamic response briefly.
- Q.5 Write the selection criteria for sensors.
- Q.6 Why PLCs are preferred to use over microcontrollers in industries?
- Q.7 How do we analyze the stability using root locus method?
- Q.8 Which displacement sensor has the slowest response time?
- Q.9 Why brushes are not used in BLDC?
- Q.10 What are the types of PLC programming languages?

[5E1718]

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M32 V 3M

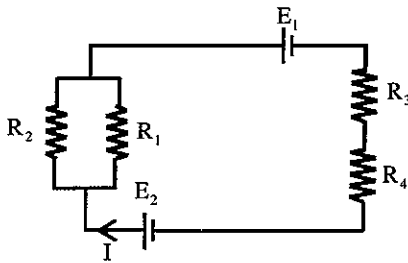
### PART - B

(Analytical/Problem solving questions)

[5×4=20]

Attempt any five questions

- Q.1 Discuss the benefits of Mechatronics in manufacturing.
- Q.2 An electric circuit consists of four resistors,  $R_1 = 12 \text{ Ohm}$ ,  $R_2 = 12 \text{ Ohm}$ ,  $R_3 = 3 \text{ Ohm}$  and  $R_4 = 6 \text{ Ohm}$ , and are connected with a source of e.m.f.  $E_1 = 6 \text{ Volt}$ ,  $E_2 = 12 \text{ Volt}$ . Determine the electric current flows in the circuit as shown in the figure below -



- Q.3 Differentiate between hydraulic and pneumatic actuators.
- Q.4 Explain the construction and working of Bipolar Junction Transistor.
- Q.5 Discuss the effect of feedback of closed loop control system.
- Q.6 What is need of modeling in mechatronic system? Comment on the modelling of electromechanical systems.
- Q.7 What are the basic operational steps in PLC programming? Draw the physical structure of PLC.

### PART - C

(Descriptive/Analytical/Problem Solving/Design Questions)

[3×10=30]

Attempt any three questions

- Q.1 Differentiate between sensors and actuators with the help of suitable examples. Explain various temperature sensors used and comment on their sensitivity and linearity.
- Q.2 Explain the modelling of one and two degrees of freedom systems. Clearly write the steps in modelling.
- Q.3 What are the different components of a microcontroller? Explain each one.
- Q.4 Discuss the application of PLC for real time industrial automation systems.
- Q.5 Explain the design of pick and place robot with the help of a case study.

**5E1719**

Roll No. \_\_\_\_\_

Total No. of Pages: **4****5E1719**

**B. Tech. V - Sem. (Main) Exam., February - 2023**  
**Automobile Engineering**  
**5AE4 – 02 Heat Transfer**  
**AE, ME**

**Time: 3 Hours****Maximum Marks: 70***Instructions to Candidates:*

*Attempt all ten questions from Part A, five questions out of seven questions from Part B and three questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination.  
(Mentioned in form No. 205)*

1. NIL2. NIL**PART – A****(Answer should be given up to 25 words only)****[10×2=20]****All questions are compulsory**

- Q.1 What is Fourier Law of Conduction?  
Q.2 Write expression of diffusion equation.  
Q.3 What do you mean by critical radius of insulation?  
Q.4 What is Biot number? What is its physical significance?  
Q.5 Convective heat transfer depends on which factors?  
Q.6 Define Nusselt number, Prandtl number and Grashof number.  
Q.7 Construct the pool boiling curve.  
Q.8 What is fouling factor?  
Q.9 Define a geometrical or shape factor.  
Q.10 Write formula for radiation heat transfer between two surfaces.

[5E1719]

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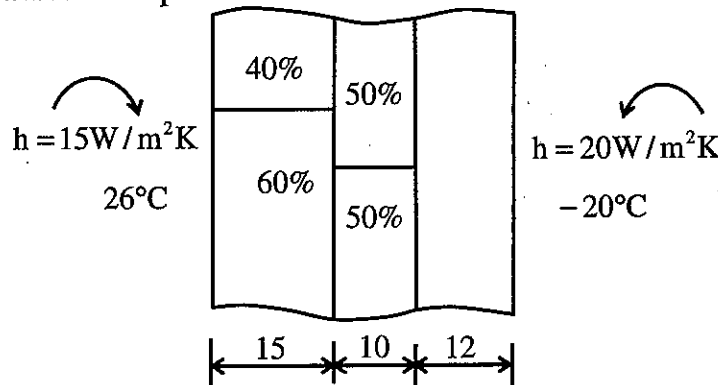
## PART – B

(Analytical/Problem solving questions)

[5×4=20]

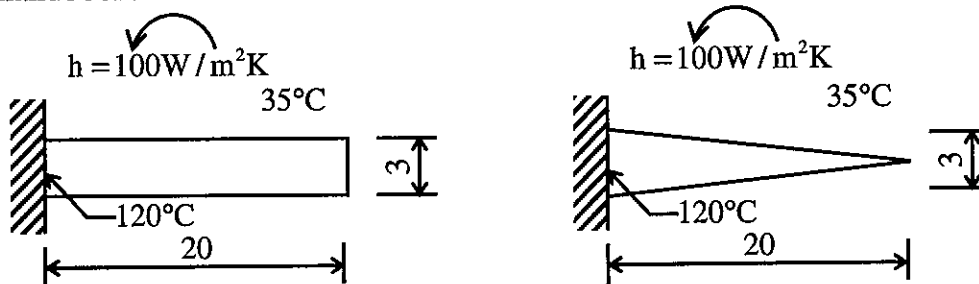
Attempt any five questions

- Q.1 A composite slab is made of three layers 15 cm, 10 cm and 12 cm thickness. The first layer is of material with thermal conductivity 1.45 for 60% of the area and the rest is of material with conductivity of 2.5 W/mK. The second layer is made of material with conductivity of 12.5 W/mK for 50% and of material with conductivity 18.5 W/mK is used for other 50%. The third layer is of single material of thermal conductivity 0.76 W/mK. The slab is exposed on one side to warm air at 26°C and to cold air at -20°C on the other side. The convection coefficients are 15 and 20 W/m<sup>2</sup>K on the inside and outside respectively. Determine the heat flow and interface temperatures.



- Q.2 Determine the heat flow for –

- (i) Rectangular fins and
- (ii) Triangular fins of 20mm length and 3mm base thickness having base temperature of 120°C. Thermal conductivity of fin material is 45W/mK. Convection heat transfer coefficient and temperature of surrounding area of fin is 100W/m<sup>2</sup>K and 35°C, respectively. Also, determine the fin effectiveness. Use heat and mass transfer data handbook.



- Q.3 A steel ball [ $c = 0.46 \text{ kJ/kg}^\circ\text{C}$ ,  $k = 35 \text{ W/m}^\circ\text{C}$ ] 5.0 cm in diameter and initially at a uniform temperature of 450°C is suddenly placed in a controlled environment in which the temperature is maintained at 100°C. The convection heat-transfer coefficient is 10 W/m<sup>2</sup>°C. Calculate the time required for the ball to attain a temperature of 150°C.

[5E1719]

Q.4 Discuss :

- (a) Hydrodynamic boundary layer and
- (b) Thermal boundary layer

Q.5 A steam pipe 50 mm diameter and 2.5 meter long has been placed horizontally and exposed to steel air at 25°C. If the pipe wall temperature is 295°C, determine the rate of heat loss.

At the mean temperature of 160°C, the thermo-physical property of air are –

Conductivity,  $k = 3.64 \times 10^{-2}$  W/m-degree

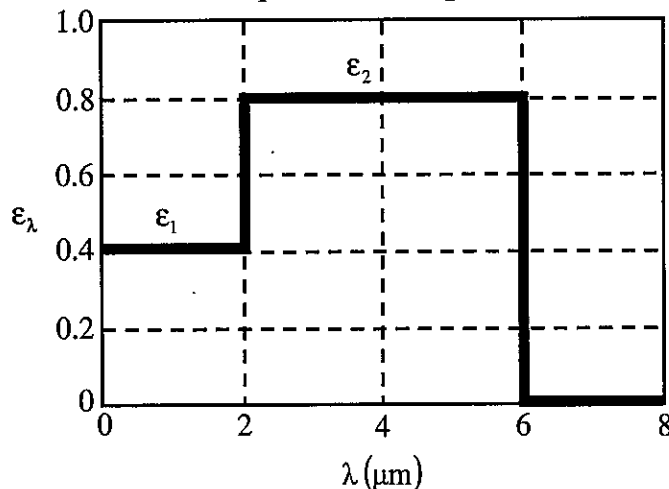
Kinematic viscosity,  $\nu = 30.09 \times 10^{-6}$  m<sup>2</sup>/s

Prandtl number,  $Pr = 0.682$

Use heat and mass transfer data book.

Q.6 A can of beverage with a height of 123 mm and a diameter of 66 mm has a uniform temperature of 5°C when it is removed from the refrigerator. The can is placed on a table in a room and moist air condenses on the outer surface of the can. Determine the dropwise condensation rate of the moisture in the air, if the saturation temperature is 25°C. The latent heat of vaporization of water at 25°C is  $2442 \times 10^3$  J/kg. Specific heat capacity of liquid at average film temperature (15°C) is 4185 J/kg.K.

Q.7 A diffuse surface at 1500K has the spectral, hemispherical emissivity shown as follows -



Determine the total hemispherical emissivity and the total emissive power. Use heat and mass transfer data book for radiation functions.

### **PART - C**

**(Descriptive/Analytical/Problem Solving/Design Questions)** [3×10=30]

**Attempt any three questions**

Q.1 Derive general heat conduction equation in cartesian coordinates.

Q.2 A 12 mm diameter mild steel sphere ( $k = 42.5$  W/mK) is exposed to cool airflow at 27°C resulting in the convective heat transfer coefficient  $h = 114$  W/m<sup>2</sup>K. Determine -

- (i) Time required to cool the sphere from 540°C to 95°C
- (ii) Instantaneous heat transfer rate 2 minutes after the start of cooling and
- (iii) Total energy transferred from the sphere during first 2 minutes.

The relevant properties of mild steel are :

Density  $\rho = 7850 \text{ kg/m}^3$

Specific heat  $c = 475 \text{ J/kg K}$  and

Thermal diffusivity  $\alpha = 0.0043 \text{ m}^2/\text{hr}$

- Q.3 Air at 2 bar pressure and 200°C temperature gets heated as it flows through 2.5 cm diameter tube with a velocity of 10 m/s. A constant heat flux condition is maintained at the wall and wall temperature is 20°C above the air temperature all along the length of the tube. Make calculations for the heat transfer per unit length of tube. Also, determine the increase in bulk temperature over a 3 meter length of the tube. The appropriate correlation for the convection coefficient is –

$$Nu = 0.023 (Re)^{0.8} (Pr)^{0.4}$$

Where the different thermo-physical properties of air are :

$\mu = 2.57 \times 10^{-5} \text{ Ns/m}^2$

$k = 0.0385 \text{ W/m-deg}$

and  $c_p = 1025 \text{ J/kgK}$

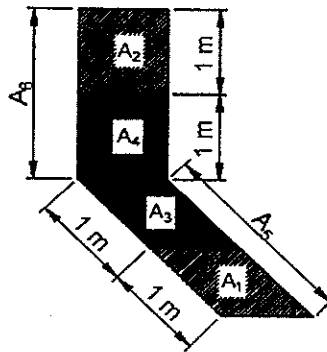
- Q.4 In an open-heart surgery under hypothermic conditions, the patient's blood is cooled before the surgery and rewarmed afterwards. The task is accomplished by a concentric tube counter-flow heat exchanger of length 500 mm with a thin-walled inner tube of 60 mm diameter. The blood entering the heat exchanger at 20°C and 0.05 kg/s. Determine the temperature of blood at exit from the heat exchanger and the heat flow rate. Assume the following data :

$c_p$  of blood = 3500 J/kgK

and  $c_p$  of water = 4186 J/kgK

Overall heat transfer coefficient  $U_0 = 475 \text{ W/m}^2 \text{ K}$

- Q.5 Find the shape factor  $F_{12}$  for the arrangement shown in the below figure. The areas  $A_1$  and  $A_2$  are perpendicular but do not share the common edge.



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Total No. of Pages: **2****5E1720**

**B. Tech. V - Sem. (Main) Exam., February - 2023**  
**Automobile Engineering**  
**5AE4 – 03 Manufacturing Technology**  
**AE, ME**

**Time: 3 Hours****Maximum Marks: 70***Instructions to Candidates:*

*Attempt all ten questions from Part A, five questions out of seven questions from Part B and three questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination. (Mentioned in form No. 205)*

1. NIL2. NIL**PART – A****(Answer should be given up to 25 words only)****[10×2=20]****All questions are compulsory**

- Q.1 State the conditions under positive and negative rake angles are recommended.
- Q.2 What are the conditions favorable for Built up Edge formation?
- Q.3 What is the effect of cutting speed and feed rate on the force on cutting tool?
- Q.4 Differentiate between cutting tool and machine tool with suitable example.
- Q.5 Differentiate between honing and lapping.
- Q.6 Differentiate between orthogonal cutting and oblique cutting.
- Q.7 Which coolants would you suggest for turning of mild steel, aluminum and copper with high speed steel tool?
- Q.8 Differentiate between up – milling and down – milling.
- Q.9 What are the abrasives used in manufacture of grinding wheels?
- Q.10 Write complete specification of a grinding wheel.

## **PART – B**

**(Analytical/Problem solving questions)**

**[5×4=20]**

**Attempt any five questions**

- Q.1 During an orthogonal cutting a chip length of 160 mm was obtained from an uncut chip length of 350 mm. The cutting tool has 220 rake angles and a depth of cut in 0.8 mm. Determine the shear plane angle and chip thickness.
- Q.2 Name the different work holding devices or methods in capstan and turret lathes. Describe any one with a neat sketch.
- Q.3 Draw a tool layout for production of hexagonal nut using turret lathe machine.
- Q.4 How the stroke length and positions are adjusted of shaper machine? Explain with a neat sketch.
- Q.5 Explain the electro – hydraulic forming process.
- Q.6 What is the principle of magnetic pulse forming? Describe the type of components that may be made by this process.
- Q.7 What are the various factors to be considered in selection of a grinding wheel? Discuss each in detail.

## **PART – C**

**(Descriptive/Analytical/Problem Solving/Design Questions)**

**[3×10=30]**

**Attempt any three questions**

- Q.1 A 125 mm long, 10 mm diameter stainless steel rod is being reduced in diameter to 9 mm by turning on a lathe. The spindle rotates at  $N = 360$  rpm and the tool is traveling at an axial speed of 175 mm/min. Let Specific energy requirement in cutting stainless steel rod is  $4 W - S / \text{mm}^3$ . Calculate the cutting speed, material removal rate, cutting time, power dissipated and cutting force.
- Q.2 A mild steel bar is turned with HSS tool. Determine the tool life for cutting velocity of 40 m/min, if the tool life equation is  $VT^{0.2} = 80$ . Also, determine the cutting speed for 60 minute tool life.
- Q.3 Enumerate the factors affecting tool life. Briefly, explain the effect of each factor.
- Q.4 Discuss the different mechanisms of tool wear.
- Q.5 Sketch a single point cutting tool and show on it the various tool elements and tool angles. Describe the tool represented by 10, 9, 6, 5, 8, 7, 1 mm in ASA system.



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Total No. of Pages: 4

**5E1721**

**B. Tech. V - Sem. (Main) Exam., February - 2023**  
**Automobile Engineering**  
**5AE4 – 04 Design of Machine Elements - I**  
**AE, ME**

**Time: 3 Hours**

**Maximum Marks: 70**

*Instructions to Candidates:*

*Attempt all ten questions from Part A, five questions out of seven questions from Part B and three questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination. (Mentioned in form No. 205)*

1. NIL

2. NIL

**PART – A**

**(Answer should be given up to 25 words only)**

**[10×2=20]**

**All questions are compulsory**

- Q.1 What are the desired characteristics of a good designer?
- Q.2 Classify plain carbon steel on the basis of carbon percentage.
- Q.3 What are the factors to be considered while selecting an engineering material?
- Q.4 What is factor of safety? Why it is sometimes called factor of ignorance?
- Q.5 What are the advantages of interchangeability?
- Q.6 What are various modes of failure of engineering materials?
- Q.7 Why third type of lever is not preferred for engineering applications?
- Q.8 What is fatigue failure? Why it is so dangerous?
- Q.9 Compare rigid coupling and flexible coupling.
- Q.10 What are the drawbacks of a saddle key? How it is different from a sunk key?

## PART – B

(Analytical/Problem solving questions)

[5×4=20]

Attempt any five questions

- Q.1 (a) Give BIS designation of engineering materials having following chemical composition-
- Free cutting steel having 0.25% Carbon, 1.2% Manganese and 0.14% Sulphur
  - Alloy steel with Carbon = 0.12 to 0.18%; Silicon = 0.15 to 0.35%;  
Manganese = 0.4 to 0.6% and Chromium = 0.5 to 0.8%
- (b) Give chemical composition of engineering materials having following BIS codes:
- X15Cr25Ni12
  - 40Ni8Cr8V2
- Q.2 A 75mm shaft rotates in a bearing. The tolerance for both shaft and bearing is 0.075mm and required allowance is 0.10mm. Determine the dimensions of the shaft and the bearing bore on the basis of hole basis system.
- Q.3 What is stress concentration? How it can be mitigated? Discuss with the help of neat sketches.
- Q.4 For a beam made of cast iron (ultimate strength as 200MPa and FOS as 2.5). Determine the dimensions of the cross section (Figure 1). The depth of the cross section is twice the width. Use maximum normal stress theory.

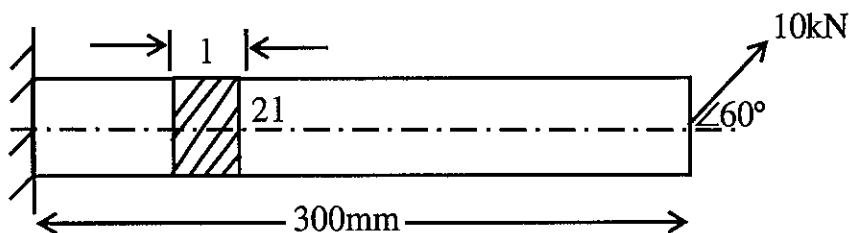


Figure 1

- Q.5 The cross-section of a flat key for a 40mm diameter shaft is 22×14mm. The power transmitted by the shaft to the hub is 25kW at 300rpm. The key is made of steel ( $\sigma_{yc} = \sigma_{yt} = 300\text{MPa}$ ) and the factor of safety is 2.8. Determine the length of the key. Assume Distortion Energy Theory.
- Q.6 A semi-elliptic leaf spring consists of two extra full-length leaves and six graduated length leaves, including the master leaf. Each leaf is 7.5mm thick and 50mm wide. The centre-to-centre distance between the two eyes is 1m. The leaves are pre-stressed in such a way that when the load is maximum, stresses induced in all the leaves are equal to 350MPa. Determine the maximum load that the spring can withstand.
- Q.7 A link of S-shape made of a round steel bar is shown in Figure 2. It is made of plain carbon steel 45C8 ( $\sigma_y = 380\text{MPa}$ ) and the factor of safety is 4.5. Calculate the dimensions of the link.

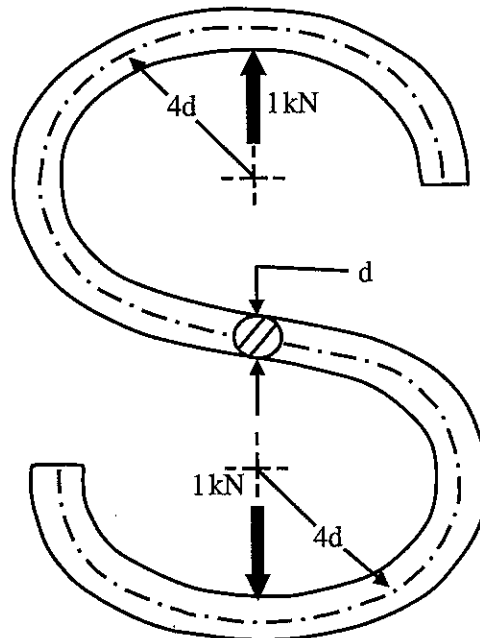


Figure 2

## **PART – C**

**(Descriptive/Analytical/Problem Solving/Design Questions)** [3×10=30]

**Attempt any three questions**

- Q.1 What are various design considerations of components made from Casting and Forging? Discuss with the help of neat sketches.
- Q.2 A protective flange coupling is used to connect two shafts and transmit 7.5kW power at 720rpm. The design torque is 150% of the rated torque. The shafts and bolts are made of plain carbon steel 30C8 ( $\sigma_y = 400\text{MPa}$ ) and the factor of safety is 5. The flanges are made of cast iron. Calculate :
- (i) Diameter of the shafts;
  - (ii) Number of bolts; and
  - (iii) Diameter of the bolts.
- Assume maximum shear stress theory.
- Q.3 Power is transmitted by a shaft 900mm long and is supported at the ends. A pulley of diameter 420mm is placed at 150mm to the left of right-hand bearing and another pulley of diameter 270mm is mounted midway between the bearing. Determine the diameter of the shaft transmitting 24kW at 300rpm using both Maximum Shear Stress Theory and Maximum Normal Stress Theory. The permissible tensile and shear stresses for the shaft material are 120MPa and 80MPa respectively. The belt drives are at right angle to each other with tension ratios as 3:1.
- Q.4 Draw a neat sketch of a Spigot and Socket Cotter joint. Also, explain the design procedure of spigot, socket and cotter with the help of governing equations.
- Q.5 A double-threaded power screw is used to raise a load of 5kN. The nominal diameter is 60mm and the pitch is 9mm. The threads are Acme type ( $2\theta = 29^\circ$ ) and the coefficient of friction at the screw threads is 0.15. Neglecting collar friction, Calculate :
- (i) The torque required to raise the load;
  - (ii) The torque required to lower the load;
  - (iii) The efficiency of the screw for lifting load.

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Roll No. \_\_\_\_\_

Total No. of Pages: **3**

**B.Tech. V-Sem. (Main) Exam., February - 2023**  
**Automobile Engg.**  
**5AE4-05 Principles of Management**  
**5E1722**  
**AE,ME**

**Time: 3 Hours**

**Maximum Marks: 70**

*Instructions to Candidates:*

*Attempt all ten questions from Part A, five questions out of seven questions from Part B and three questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination.  
(Mentioned in form No. 205)*

1. NIL

2. NIL

**PART – A**

**[10×2=20]**

**(Answer should be given up to 25 words only)**

**All questions are compulsory**

- Q.1 What are the functions of Management?
- Q.2 Define the term “Departmentation”.
- Q.3 What is Effective Communication?
- Q.4 What is Delegation?
- Q.5 “Planning is looking ahead and controlling is looking back” comment.

- Q.6 What is MBO?
- Q.7 Define the term "Performance Appraisal".
- Q.8 What is an Organisation?
- Q.9 Discuss the productivity problems in a management.
- Q.10 What are the elements in the Maslow's Hierarchy of needs?

**PART – B**

**[5×4=20]**

**(Analytical/Problem solving questions)**

**Attempt any five questions**

- Q.1 Define Management. Explain briefly the principles of Management according to Fayol.
- Q.2 Explain the different types of Communication.
- Q.3 Explain the concept of Decision Making.
- Q.4 Write a note on the following:
- (a) Organisation Structure
  - (b) Organisation Culture
- Q.5 Write a note on the following:
- (a) Span of Management
  - (b) Coordination
- Q.6 Write a note on the following:
- (a) Motivation
  - (b) Leadership
- Q.7 Explain the Two - Factor theory of Motivation and McGregor's Theory X and Theory Y?

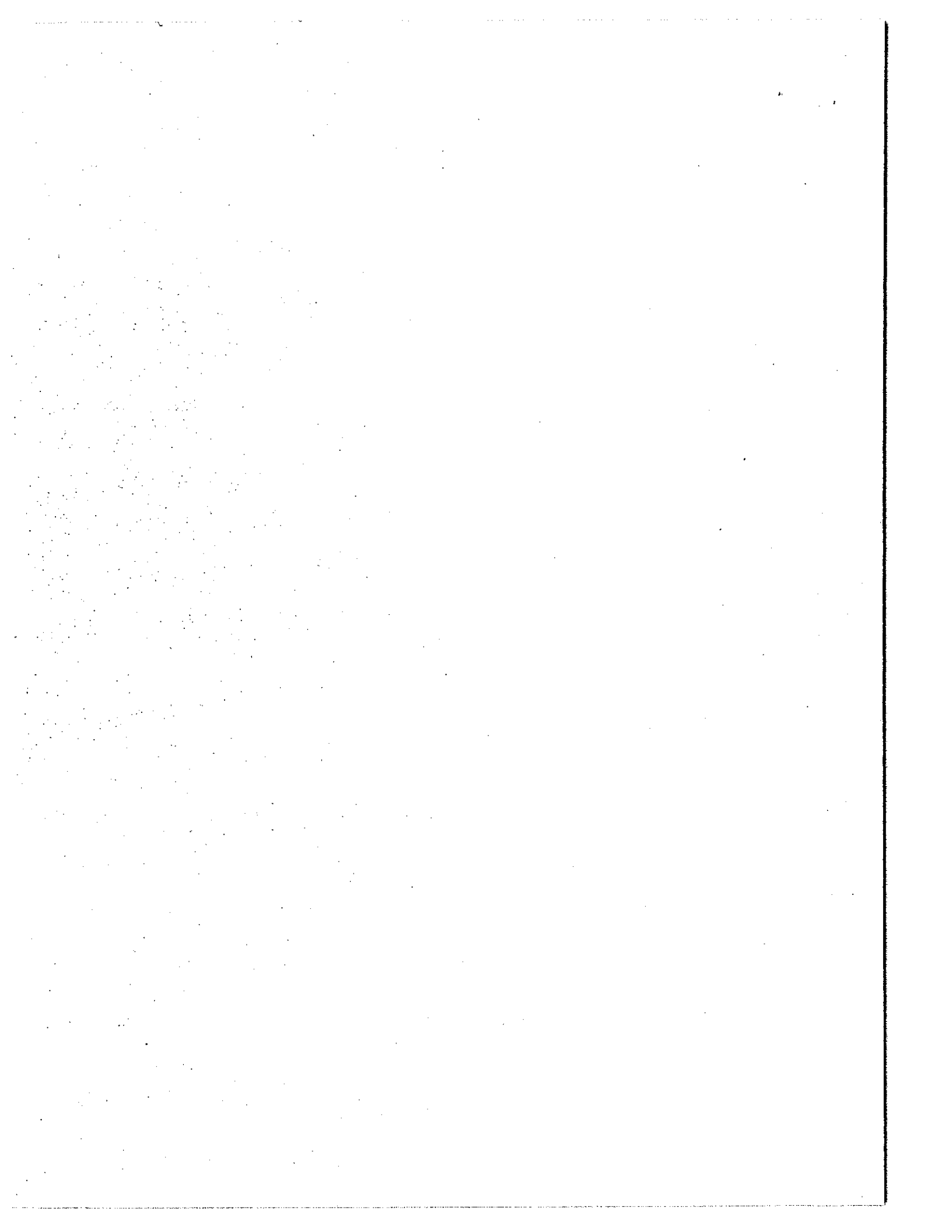
**PART – C**

**[3×10=30]**

**(Descriptive/Analytical/Problem Solving/Design Questions)**

**Attempt any three questions**

- Q.1 Write a note on the following:
- (a) Control Techniques and Information Technology
  - (b) Performance Appraisal and Career Strategy
- Q.2 What is Controlling? Explain the system and process of Controlling.
- Q.3 What do you understand by Managerial Ethics? How are these classified?
- Q.4 Differentiate between Centralisation & Decentralisation. Explain the advantages and disadvantages of Centralisation & Decentralisation.
- Q.5 Explain the concept of Total Quality Management (TQM).
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Roll No. \_\_\_\_\_

Total No. of Pages: 2

**5E1724**

**B. Tech. V - Sem. (Main) Exam., February - 2023**  
**Automobile Engineering**  
**5AE5 – 12 Automobile Engineering (Elective-I)**  
**AE, ME**

**Time: 3 Hours**

**Maximum Marks: 70**

*Instructions to Candidates:*

*Attempt all ten questions from Part A, five questions out of seven questions from Part B and three questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination. (Mentioned in form No. 205)*

1. NIL

2. NIL

**PART – A**

**(Answer should be given up to 25 words only)**

**[10×2=20]**

**All questions are compulsory**

- Q.1 Define toe in and toe out.
- Q.2 Give the name of various components of chassis.
- Q.3 Define over steering and under steering.
- Q.4 What are the functions of clutch?
- Q.5 What is synchromesh device?
- Q.6 Explain the all wheel drive.
- Q.7 Write various types of steering gear boxes.
- Q.8 Describe the advantages of radial ply tyres over bias ply tyres.
- Q.9 List the common faults related to automotive air conditioning system.
- Q.10 List the various safety requirements of an automobile.

## **PART – B**

**(Analytical/Problem solving questions)**

**[5×4=20]**

**Attempt any five questions**

- Q.1 Explain the hydraulic torque converter.
- Q.2 Explain the operations of disc brake and drum brake system. Write its advantage and disadvantages.
- Q.3 Explain the constructional features of rear suspension system using leaf spring.
- Q.4 What is the necessity of differential in an automobile? Explain the construction and function of differential.
- Q.5 Draw and explain the layout of the vehicle battery charging system.
- Q.6 Explain the working principle of alternator and how alternator voltage and current output are controlled?
- Q.7 Explain, how does automobile air conditioning system differ from domestic air conditioning system?

## **PART – C**

**(Descriptive/Analytical/Problem Solving/Design Questions)**

**[3×10=30]**

**Attempt any three questions**

- Q.1 Explain the working of an automotive air conditioning system along with function of all component. How the evaporator icing is controlled?
- Q.2 Draw and explain hydraulic power brakes. What is the function of viscosity in hydraulic braking system? How bleeding can be done in such braking system?
- Q.3 What are the functions of wheel in an automobile? Explain the types and constructional features of tyre.
- Q.4 Explain the significance and features of night vision system and global positioning system.
- Q.5 What are the different types of gear boxes? With the help of neat sketch, explain the construction and working of sliding mesh gear box.
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5E1321

Roll No. \_\_\_\_\_

Total No. of Pages: 2

**5E1321**

**B. Tech. V - Sem. (Back) Exam., February - 2023**  
**ESC Automobile Engineering**  
**5AE3 – 01 Mechatronic Systems**  
**AE, ME**

**Time: 2 Hours**

**Maximum Marks: 80**  
**Min. Passing Marks: 28**

*Instructions to Candidates:*

*Attempt all five questions from Part A, four questions out of six questions from Part B and two questions out of three from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination. (Mentioned in form No. 205)*

1. NIL

2. NIL

**PART – A**

**(Answer should be given up to 25 words only)**

**[5×2=10]**

**All questions are compulsory**

- Q.1 What are the parameters to be considered for designing an intelligent Mechatronics system?
- Q.2 Identify the sensors in a pick and place robot.
- Q.3 What are the advantages of using a microprocessor in place of mechanical controller in a carburetor of an automobile?
- Q.4 What are the advantages and disadvantages of PID Control?
- Q.5 Write the advantages of an FET over a BJT.

## **PART – B**

**(Analytical/Problem solving questions)**

**[4×10=40]**

**Attempt any four questions**

- Q.1 Draw a block diagram of a basic microcontroller and explain the function of each subsystems.
- Q.2 Explain, how a Thyristor can be used to control the level of a DC voltage by chopping the output from a constant voltage supply.
- Q.3 What is a programmable logic controller and how is it different from a microprocessor/microcontroller system?
- Q.4 Identify and explain the sensor, signal conditioner and display element in the measurement system of a Bourdon pressure gauge.
- Q.5 Draw a typical pneumatic circuit and explain its working.
- Q.6 Identify and explain the functions of the various control elements of an automatic camera.

## **PART – C**

**(Descriptive/Analytical/Problem Solving/Design Questions)**

**[2×15=30]**

**Attempt any two questions**

- Q.1 What are the various types of models used to describe a system? Explain the mathematical models with suitable examples.
- Q.2 Draw the architecture of an 8051 microcontroller and explain the role of each component.
- Q.3 Design a vehicle engine management system on the basis of mechatronics system design.
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5E1322

Roll No. \_\_\_\_\_

Total No. of Pages: 4

**5E1322**

**B. Tech. V - Sem. (Back) Exam., February - 2023**

**Automobile Engineering**

**5AE4 – 02 Heat Transfer**

**AE, ME**

**Time: 3 Hours**

**Maximum Marks: 120**

**Min. Passing Marks: 42**

*Instructions to Candidates:*

*Attempt all ten questions from Part A, five questions out of seven questions from Part B and four questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination. (Mentioned in form No. 205)*

1. NIL

2. NIL

**PART – A**

**(Answer should be given up to 25 words only)**

**[10×2=20]**

**All questions are compulsory**

- Q.1 Define the thermal conductivity, thermal resistance and thermal conductance.
- Q.2 Define thermal diffusivity and explain its physical significance.
- Q.3 Write Fourier rate equation for heat transfer by conduction?
- Q.4 What is the overall heat transfer coefficient?
- Q.5 What is the extended surfaces? Give example.
- Q.6 What type of boundary condition is used at the fin edge?
- Q.7 Name the most common types of fins with sketch.

- Q.8 What is meant by lumped-capacity?
- Q.9 Define terms absorptivity, reflectivity and transmissivity of a body.
- Q.10 State the Stefan Boltzmann Law.

## PART – B

(Analytical/Problem solving questions)

[5×8=40]

Attempt any five questions

- Q.1 Show that for an incompressible homogeneous fluid with no internal heat generation, the energy equation can be expressed by -

$$\frac{Dt}{Dt} = a\nabla^2 t$$

- Q.2 A 1.2 m thick slab of concrete ( $k = 1.148 \text{ W/m-deg}$ ) having both side surface temperature of  $20^\circ\text{C}$ . During curing energy released at the rate of  $80 \text{ W/m}^3$ . Assuming that temperature not varying with time, determine the maximum temperature of concrete. What would be the maximum thickness of concrete if the temperature gradient is limit to  $98.5^\circ\text{C/m}$  anywhere in the slab?

- Q.3 Derive the governing differential equation for temperature distribution of constant area extended surface in the following form -

$$\frac{d^2 t}{dt^2} = \frac{hp}{kA_c} = m^2 \theta$$

- Q.4 Prove that the temperature of a body at any time  $\tau$  during Newtonian heating or cooling is given by the relation -

$$\frac{t-t_a}{t_1-t_a} = \exp[B_1 F_0]$$

- Q.5 Show the temperature variation along the length of heat exchanger when:
- (i) hot and cold fluids flow in parallel and counter flow fashion
  - (ii) steam condenses on the outside of condenser tubes and water flowing inside the tubes as coolant.

- Q.6 Using the definition of radiosity and irradiation, prove that the radiant interchange between two gray bodies is given by relation:

$$Q_{\text{net}} = \frac{A_1 a_b (T_1^4 - T_2^4)}{\left\{ \frac{1-\epsilon_1}{\epsilon_1} \right\} + \left\{ \frac{1}{F_{12}} \right\} + \left\{ \frac{1-\epsilon_2}{\epsilon_2} \right\} \times \left\{ \frac{A_1}{A_2} \right\}}$$

- Q.7 A counter-flow concentric tube heat exchanger is used to cool the lubricating oil of a large industrial gas turbine engine. The oil flows through the tube at 0.19 kg/s ( $C_p=2.18$  kJ/kg K), and the coolant water flows in the annulus in the opposite direction at the rate of 0.15 kg/s ( $C_p = 4.18$  kJ/kg K). The oil enters the oil enters the coolant at 425 K and leaves at 345 K while the coolant enters at 285 K. How long must the tube be made to perform this duty if the heat transfer coefficient from oil to tube surface is 2250 W/m<sup>2</sup> K and from tube surface to water is 5650 W/m<sup>2</sup> K? The tube has a mean diameter of 12.5mm and its wall presents negligible resistance to heat transfer.

### PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) [4×15=60]

#### Attempt any four questions

- Q.1 Explain the analogy between heat transfer by conduction and flow of electricity through Ohmic resistance. Illustrate the concept by considering composite wall of building.
- Q.2 Explain Nusselt number. How it is related to temperature gradient in the fluid immediately in contact with the solid surface? Mention the various approaches which have suggested for estimating the value of Nusselt number.
- Q.3 Two parallel walls each 1.25 m height, from 7.5 cm thick vertical slot containing air at atmospheric pressure. Make calculation for the effective thermal conductivity and heat flux if the hotter and cooler walls are at 77°C and 27°C temperature respectively.

Q.4 Example 14.18 A one-shell, two-tube pass heat exchanger having 3000 thin wall brass tubes of 20 mm diameter has been installed in a steam power plant with a load of  $2.3 \times 10^8$  W. The steam condenses at  $50^\circ\text{C}$  and the cooling water enters the tube at  $20^\circ\text{C}$  at the rate of 3000 kg/s. Calculate the overall heat transfer coefficient, the tube length per pass and the rate of condensation of steam. Take the heat transfer coefficient for condensation on the outer surfaces of the tubes as  $15500\text{ W/m}^2\text{ K}$  and latent heat of steam as  $2380\text{ kJ/kg}$ . Further presume the following fluid properties -

$$c = 4180\text{ J/kg K}, \mu = 855 \times 10^{-6}\text{ Ns/m}^2, k = 0.613\text{ W/m K and Pr} = 5.83$$

Q.5 For laminar film condensation on a vertical plate, develop an expression for the film thickness, heat transfer coefficient and steam condensation rate in terms of relevant fluid properties, temperature difference and plate dimensions. Are the fluid properties involved evaluated for the vapour phase? If not, how are they evaluated?

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**5E1324**

**B. Tech. V - Sem. (Back) Exam., February - 2023**

**Automobile Engineering**

**5AE4 – 04 Design of Machine Elements - I**

**AE, ME**

**Time: 3 Hours**

**Maximum Marks: 120**

**Min. Passing Marks: 42**

*Instructions to Candidates:*

*Attempt all ten questions from Part A, five questions out of seven questions from Part B and four questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination.  
(Mentioned in form No. 205)*

1. NIL

2. NIL

**PART – A**

**(Answer should be given up to 25 words only)**

**[10×2=20]**

**All questions are compulsory**

Q.1 What is the purpose of standardization?

Q.2 What do you mean by preloading of bolts?

Q.3 A hole of 50mm has tolerance as C10. Calculate the maximum and minimum sizes.

Q.4 What is meant by rigidity of a shaft?

Q.5 Name various types of coupling.

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- Q.6 What do you mean by Nipping? Why it is done for leaf springs?
- Q.7 What are parameters to be considered while selecting a suitable material?
- Q.8 Define surface roughness and what is the unit to measure it?
- Q.9 Define fits and Name different types of fits.
- Q.10 What is meant by self-locking screw? What is the efficiency of such screws?

### **PART – B**

**(Analytical/Problem solving questions)**

**[5×8=40]**

**Attempt any five questions**

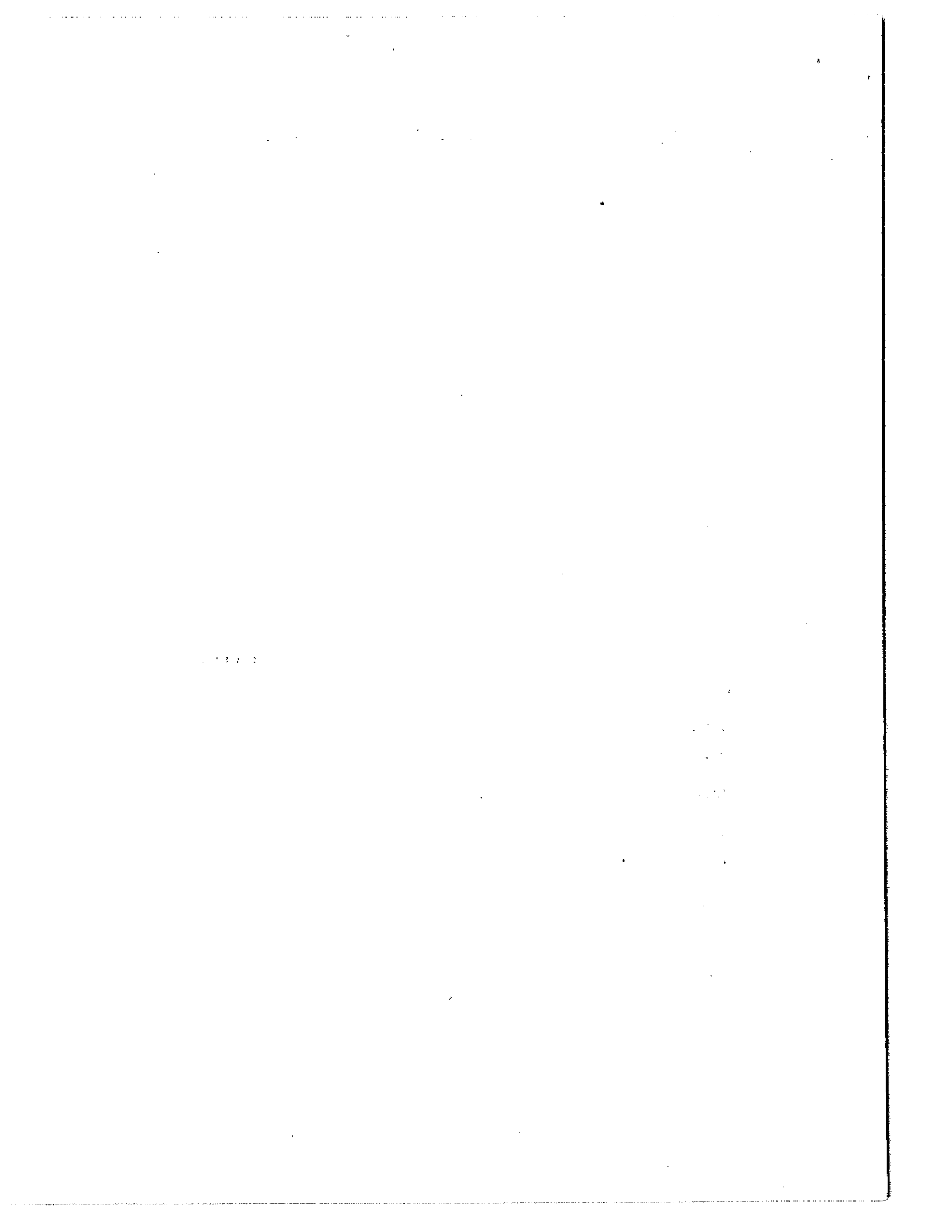
- Q.1 Derive an expression for the maximum efficiency of a power screw.
- Q.2 A solid shaft is transmitting 1 MW at 240 rpm. Determine the diameter of the shaft if the maximum torque transmitted exceeds the mean torque by 20%. Take the maximum allowable shear stress at 60 MPa.
- Q.3 Describe the various terms used in reference to threads with a sketch.
- Q.4 Distinguish between cotter and knuckle joint. Also, write their applications.
- Q.5 Determine the design stress for a piston rod where the load is completely reversed. The surface of the rod is ground and the surface factor is 0.9. There is no stress concentration. The load is predictable and factor of safety is 2.
- Q.6 A shaft has basic size of 50 mm with its limits as 49.8 mm and 49.7 mm. Find its fundamental deviation zone and IT grade tolerance.
- Q.7 Define stress concentration and methods of reducing it.

## PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) [4×15=60]

Attempt any four questions

- Q.1 A locomotive semi elliptical laminated spring has an overall length of 1m and sustains a load of 70kN at its centre. The spring has 3 full length leaves and 15 graduated leaves with a central band of 100mm width. All the leaves are to be stressed to 400MPa, when fully loaded. The ratio of the total depth to that of width is 2.  $E = 210 \text{ kN/mm}^2$ . Determine –
- (a) The thickness and width of leaves
  - (b) The initial gap that should be provided between the full length and graduated leaves before the band load is applied.
  - (c) The load exerted on the band after the spring is assembled.
- Q.2 Calculate the tolerances, fundamental deviations and limits of sizes for the shaft designated as 40H8/f7.
- Q.3 Define any ten mechanical properties.
- Q.4 Design and draw a cotter joint to support a load varying from 30kN in compression to 30kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically.
- Given, Tensile stress = compressive stress = 50MPa, shear stress = 35MPa and Crushing stress = 90MPa.
- Q.5 Design and make a neat sketch of muff coupling which is used to connect two steel shafts transmitting 40kW at 350 rpm. The materials 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 15MPa.
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**5E1327**

**B. Tech. V - Sem. (Back) Exam., February - 2023**  
**Automobile Engineering**  
**5AE5 – 12 Automobile Engineering**  
**AE, ME**

**Time: 3 Hours**

**Maximum Marks: 120**  
**Min. Passing Marks: 42**

*Instructions to Candidates:*

*Attempt all ten questions from Part A, five questions out of seven questions from Part B and four questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.*

*Use of following supporting material is permitted during examination. (Mentioned in form No. 205)*

1. NIL

2. NIL

**PART – A**

**(Answer should be given up to 25 words only)**

**[10×2=20]**

**All questions are compulsory**

Q.1 Explain the function of centrifugal clutch.

Q.2 Define the role of synchromesh gear box.

Q.3 List the various safety devices used in Automobile.

Q.4 Define overdrive in Automobile.

Q.5 What are the loads coming on a chassis frame?

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- Q.6 Compare Hotchkiss and Torque tube drive.
- Q.7 List the common faults related to automotive air conditioning system.
- Q.8 What do you mean by tyre retreading?
- Q.9 What do you mean by power steering?
- Q.10 Explain the purpose and features of battery charging system.

### **PART – B**

**(Analytical/Problem solving questions)**

**[5×8=40]**

**Attempt any five questions**

- Q.1 How is frame different from chassis? Discuss the design aspects and salient features of frame.
- Q.2 State the principle and derive the relation for correct steering of vehicle. Hence draw “Ackerman’s Steering Mechanism” and explain wheel lock and steering lock angles.
- Q.3 Explain the Magneto Ignition System with the help of schematic diagram. Compare its merits and demerits with Battery Ignition System.
- Q.4 Explain the construction and working of Hydraulic Torque Converter.
- Q.5 Write short notes on the following.
- (i) Head Lamp
  - (ii) Night vision system
  - (iii) Caster and Camber
  - (iv) Propeller shaft & universal joint
- Q.6 Describe briefly the construction and working of Alternator. Explain its principle and how voltage output is controlled?
- Q.7 What is refrigerant? Explain different types of refrigerants with their applications.

**PART – C**

**(Descriptive/Analytical/Problem Solving/Design Questions)** [4×15=60]

**Attempt any four questions**

- Q.1 Draw starter motor for automobile. Indicate all the parts and their roles and limitations.
- Q.2 What is the difference between sprung and un-sprung weight? Describe independent rear suspension system with neat sketch and explain how it affects ride quality?
- Q.3 List the advantages of variable displacement compressor over fixed displacement compressor in automotive air conditioning system. Explain safety devices used in automobiles.
- Q.4 How the size of clutch plate is determined? How does the uniform pressure criteria differ from the uniform wear consideration? How does the mean effective radius affect the torque transmitting ability in both the design criteria?
- Q.5 Explain the following with proper sketch –
- (i) Global Positioning System
  - (ii) Fuel Level Indicator
  - (iii) Toe in and Toe out
  - (iv) Brake shoes and Vacuum Brake
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