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5E6201

Roll No. : _____ Total Printed Pages : 4

5E6201

B. Tech. (Sem. V) (Main / Back) Examination, November - 2018
Mech. Engineering
5ME1A Heat Transfer

Time : 3 Hours] **[Maximum Marks : 80**
[Min. Passing Marks : 26

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing 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. Heat Transfer Data Book 2. NIL

UNIT - I

1 (a) Write the Fourier rate equation for heat transfer by conduction. Also explain parameters which influence the value of heat transfer coefficient. **8**

(b) A container with outside surface area 0.36 m^2 and outside temperature of 0°C contains ice at 0°C. The container is placed in ambient air at 24°C and the surface coefficient of heat transfer between the container surface and the surrounding air is estimated to be 6.25 W/m^2 deg. Calculate the rate of which ice would be changed into liquid water. Take latent heat of fusion of ice as 340 J/g. **8**

OR

1 (a) Derive the general conduction equation for cylindrical coordinates system being with uniform heat generation and unsteady state.

6

(b) A steam main 75 mm inside diameter and 90 mm outside diameter is lagged with two successive layers of insulation. The layer in contact with the pipe is 38 mm asbestos and the asbestos layer is covered with 25 mm thick magnesia insulation. The surface coefficients for inside and outside surface are 227 W/m^2k and 6.8 W/m^2k respectively. If the steam temperature 375°C and the ambient temperature is 35°C, calculate the steady loss of heat from steam for 60 m length of pipe.

10

UNIT - II

2 (a) Derive the heat dissipation from an infinitely long fin and fin efficiency.

8

(v) A long cylindrical bar of radius 7.5 cm comes out of an oven at 815°C through out and is cooled by quenching it in a large bath of 38°C coolant. If the surface coefficient of heat transfer between the bar surface and the coolant is 175 W/m^2-deg. Calculate the time it takes for the shaft centre to reach 116°C. Assume that k = 17.5 W/m-deg. and α = 0.0185 m^2/hr.

8

OR

2 (a) What do you understand by hydrodynamic and thermal boundary layers ? Illustrate with reference to flow over a flat heated plate.

8

(b) Define the 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.

8

UNIT - III

3 (a) Explain Reyleigh method and the Buckingham's π theorem for dimensional analysis. What are repeating variables and how are they selected for dimensional analysis ?

8

(b) A steam pipe 6 cm in diameter is covered with 2 cm thick layer of insulation which has a surface emissivity of 0.92. The insulation surface temperature is 75°C and the pipe is placed in atmospheric air a 25°C. Considering heat loss both by radiation and natural convection, estimate the heat loss from 5 m length of pipe. Also calculate overall heat transfer coefficient.

8

OR

3 (a) Explain the different regimes of foiling heat transfer with the help of boiling curve coordinates.

6

(b) A copper pan of 35 cm diameter contains water and its bottom surface is maintained at 115°C by an electric heater. Calculate the power required to boil water in this pan and the rate at which water evaporates from the pan due to the boiling process. Also make calculations for the heat flun for these conditions.

10

UNIT - IV

4 (a) Working in terms of inlet and outlet temperature of the fluids and overall heat transfer coefficient, develop an expression for the heat transfer from one fluid to another in 9 conventional (i) Parallel flow (ii) Counter flow heat exchanger.

8

(b) A heat exchanger with 2 shell passes and 4 tube passes is used to cool oil (C_p = 3.55 kj/kg K) from 125°C to 50°C flowing at the rate of 2.5 kg/s. The cooling water (C_p = 4.18 kJ/kg k) enters the shell at 20°C with a flow rate of 3 kg/s and the overall heat transfer coefficient for the exchanger has been estimated at 115 W/m^{2}k. Calculate heat transfer through heat exchanger and area to accomplish the specified energy transfer.

8

OR

359

4 (a) Derive the relationship between the effectiveness and the number of transfer units for a counter flow heat exchanger. **6**

(b) The engine oil at 150°C is cooled to 80°C in a parallel flow heat exchanger by water entering at 25°C and leaving at 60°C. Estimate the exchanger effectiveness and the number of transfer units. If the fluid flow rates and the inlet conditions remain unchanged, work out the lowest temperature to which the oil may be cooled by increasing length of exchanger. **10**

UNIT - V

5 (a) Derive a general relation for the radiation shape factor in case of radiation between two surface. **6**

(b) A domestic hot water tank 0.5 m diameter and 1m high is located in a large space effectively forming block surrounding. The surface emissivity and temperature are 0.8 and 350 k, and the temperature of surroundings is 295 k. Estimate the heat loss by radiation from the tank and suggest a possibility to reduce this heat loss. **10**

OR

5 (a) Explain the salient features and characteristics of radiation. **8**

(b) A stainless steel plate (E=0.6) at 100°C faces a brick wall (E = 0.75) 500°C. Estimate the heat flux and radiant heat transfer coefficient. **8**

360

5E6202

Roll No. : _____ Total Printed Pages : 3

5E6202

B. Tech. (Sem. V) (Mercy Back) Examination, November 2018
Mechanical Engineering
5ME2A Dynamics of Machines (AE, ME)

Time : 3 Hours **Maximum Marks : 80**
Min. Passing Marks : 24

*Attempt any **five** questions, selecting **one question** from **each unit**. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing 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

UNIT - I

1 (a) Classify Governors in various categories. **6**

(b) Derive the relationship between Height of the Governor and its speed for a proell Governor. **10**

OR

1 Define any two terms :

(i) Sensitiveness

(ii) Isochronism and stability of Governor

(iii) Hunting of Governor. **8×2=16**

361

UNIT - II

2 (a) Discuss the effect of the Governor couple on a two wheeled vehicle taking a turn. **8**

(b) Derive an expression for the angular acceleration of the connecting rod of a Reciprocating engine. **8**

OR

2 An aeroplane flying with the speed of 200 km/hr turns towards right and completes a quarter circle of 50 m radius. The mass of the rotary engine and the propeller of the plane amounts to 400 kg with a radius of gyration of 300 mt. The engine speed is 1500 rpm. clockwise when viewed from the front. Determine the gyroscopic couple on the air craft and state its effect. In what way the effect changed when the aeroplane turns towards left ? **16**

UNIT - III

3 (a) With the help of a neat sketch derive the condition for minimum no. of teeth on wheel to avoid interference. **10**

(b) What do mean by undercutting of Gears ? **6**

OR

3 A pinion of 32 involute teeth and 4 mm module driver a rack. The pressure angle is 20^{o}. the Addendum of both pinion and of the Addendum to avoid interference. Also find the number of pairs of teeth in contact. **16**

362

UNIT - IV

4 (a) Explain the working of a sliding mesh gear box. **8**

(b) Discuss the speed ratio of a compound gear train. **8**

OR

4 Draw a neat sketch of sun and planet gear arrangement. Using tabular method derive the expression for speed of arm when sun wheel is fixed and when annular wheel is fixed respectively. **16**

UNIT - V

5 (a) Explain the effect of partial balancing in locomotives. **8**

(b) Describe any one type of static balancing machine. **8**

OR

5 The axis of a three-cylinder air compressor are at 120^{o} to one another and their connecting rods are coupled to a single crank. The length of each connecting rod is 240 mm and the stroke is 160 mm. The reciprocating parts have a mass of 2.4 kg per cylinder. Determine the primary and secondary forces if the engine runs at 2000 rpm. **16**

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5E6203

Roll No. : _____ Total Printed Pages : 3

5E6203

B. Tech. (Sem. V) (Main / Back) Examination, November - 2018
Mech. Engineering
5ME3A Measurement & Metrology

Time : 3 Hours] **[Total Marks : 80**
[Min. Passing Marks : 26

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing 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

UNIT - I

1 (a) Give the structure of generalized measuring system and explain in detail. **6**

(b) In a Wheatstone bridge a change of 9Ω in the unknown arm of the bridge is required to produce a change in the deflection of 3mm of the galvanometer. Determine :
(i) Sensitivity, and
(ii) Deflection factor **6**

(c) Differentiate between the terms "repeatability" and "Reproducibility". **4**

OR

364

1 (a) Explain various types of errors while measurement, and important ways to eliminate them. **6**

(b) A wattmeter having a range of 500W has an error of ± 1.5 percent of full scale deflection. If the true power is 50W, what would be the range of the reading ? **4**

(c) Explain the purpose of calibrating as instrument and discuss the various calibrating instruments. **6**

UNIT - II

2 (a) State the main requirements of slip gauges. How are slip gauges manufactured ? **8**

(b) Describe the constructional details of an angle Decker and explain how it is used to measure the angle. **8**

OR

2 (a) Explain Reed type mechanical comparator. **4**

(b) Why is sine bar not suitable for measuring angles above 45° ? Also mention sources of errors in sine bar. **6**

(c) Describe briefly the construction and working principle of autocollimator. **6**

UNIT - III

3 (a) Explain a method of measuring errors in the pitch of a screw thread. **8**

(b) Explain working of Parkinson gear tester with neat sketch. **8**

OR

365

3 (a) Explain how V-Block and three point probe are used for measurement of roundness. What are the limitations of V-Block ? **10**

(b) Explain Tomlinson surface meter in detail. **6**

UNIT - IV

4 (a) Explain with the help of a neat sketch, the principle and working of laser interferometer. State its application in machine tool metrology. **12**

(b) Name the alignment tests performed on milling machine. **4**

OR

4 Explain various types of coordinate measuring machines with a neat sketch. **16**

UNIT - V

5 (a) Describe the construction of a hydraulic dynamometer and explain how it is used for power measurement ? **8**

(b) With a sketch explain the torque measurement using strain gauges. **8**

OR

5 (a) Draw a simple sketch of a non-contact type temperature measuring instrument and describe each element. **8**

(b) With a neat sketch explain the velocity measurement using Hot Wire Anemometer. **8**

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5E3177

Roll No. : _____ Total Printed Pages : 4

5E3177

B. Tech. (Sem. V) (Mercy Back) Examination, November - 2018
Mechanical Engineering
5ME3(O) Fundamentals of Aerodynamics

Time : 3 Hours] **[Total Marks : 80**
[Min. Passing Marks : 24

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing 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

UNIT - I

1 (a) Explain the Kelvin's circulation theorem. Calculate the lift over an airfoil. **8**

(b) A wing of an aircraft of 10 m span and 2 m mean chord is designed to develop a lift of 45 KN at a speed of 400 km/h. A 1/20 scale model of the wing section is tested in a wind tunnel at 500 m/sec. and T=5.33 kg/m^3. The total drag measured is 400 N. Assuming that the wind tunnel data refer to a section of infinite span, calculate the total drag for the full size wing. Assume an elliptical lift distribution and take air density as 1.2 kg/m^3. **8**

OR

1 What do you mean by centre of pressure of an airfoil ? What would be the nomenclature for the integration of pressure and shear stress distribution over a two dimensional body surface ? Find out the expression for total and axial force per unit span.

16

UNIT - II

2 (a) Explain symmetrical and non-symmetrical aerofoil.

6

(b) Explain cascade nomenclature and turbine cascade nomenclature. Also differentiate them.

10

OR

2 (a) A compressor cascade is working with air of 1.25 kg/m^3 density and 100 m/s velocity at the entry. The air is making angles of 50° and 25° at entry and exit respectively. The pitch to cord ratio of the compressor cascade is 1./5. If the stagnation pressure loss is 15 mm. determine the pressure loss coefficient, lift coefficient and drag coefficient.

10

(b) Calculate the energy transfer in terms of lift and drag.

6

UNIT - III

3 (a) Sketch the variation of area, velocity and pressure for isentropic flow through subsonic and supersonic nozzle.

8

(b) Derive the following relation for isentropic flow :

(i) $$\frac{dp}{p} = \left[\frac{M^2}{1-M^2}\right]\frac{dA}{A}$$

(ii) $$\frac{dv}{v} = \left[\frac{1}{1-M^2}\right]\frac{dA}{A}$$

where all the notations have their usual meanings.

4×2=8

OR

360

3 (a) Explain the phenomenon of choking in isentropic flow. 6

(b) Air is discharged from a reservoir at 1 MB and 500 K through a nozzle to an exit pressure of 0.09 MPa. If the flow rate through the nozzle is 3600 kg/h, determine following for isentropic flow :

(i) Throad area, pressure and velocity

(ii) Exit Area and Mach Number. 10

UNIT - IV

4 (a) Explain the change in entropy and also explain the choking due to friction. 8

(b) Define fanno lines. What is the necessity of fanno lines in fluid flow ? 8

OR

4 (a) Differentiate between fanno flow and Rayleigh flow. 4

(b) Drive expressions for :

(i) Pressure ratio,

(ii) Stagnation pressure ratio,

(iii) Temperature ratio,

(iv) Stagnation Temperature Ratio,

(v) Density Ratio and

(vi) Velocity Ratio.

Assume finite control volume in Rayleigh flow. 12

UNIT - V

5 (a) Derive the following relationship for a normal shock wave :

$C_x \, C_y = (a^*)^2$

Where

C_x = Velocity before shock

C_y = Velocity after shock

a^* = critical velocity of sound

8

(b) Define the equation for Rankine-Hugoniot relations for normal shock.

8

OR

5 Write short note on any four :

(a) Angle of attack

(b) Rayleigh line

(c) Convergent-Divergent nozzle

(d) Lift and drag coefficient

(e) Prandtl's relation

(f) Increase in entropy.

4×4=16

370

5E6204

Roll No. : _____ Total Printed Pages : 4

5E6204

B. Tech. (Sem. V) (Main/Back) Examination, November 2018
Mechanical Engg.
5ME4A Quality Assurance and Reliability

Time : 3 Hours **Total Marks : 80**
Min. Passing Marks : 24

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing 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

UNIT - I

1 (a) Discuss the cost of quality in detail. **6**

(b) Differentiate between :
(i) Inspection and Quality Control, and
(ii) Quality of design and Quality of conformance. **5+5**

OR

1 (a) Explain the various types of continuous probability distributions. **8**

(b) A machine shop produces steel pins. The width of 100 pins was checked after machining and data was recorded as follows :

Width in mm	Frequency	Width in mm	Frequency
9.50 - 9.51	6	9.58 - 9.59	22
9.52 - 9.53	2	9.60 - 9.61	8
9.54 - 9.55	20	9.62 - 9.63	6
9.56 - 9.57	32	9.64 - 9.65	4

(i) Find the arithmetic mean, standard deviation and variance.
(ii) What percentage of the pins manufactured has width of 9.52 to 9.63 ?

8

UNIT - II

2 (a) Define SQC and discuss the benefits of SQC.

8

(b) Describe the method of constructing $\overline{X}$ and R charts.

8

OR

2 (a) What is meant by process capability ? How will we determine the same ?

6

(b) The following table shows the averages and ranges of the spindle diameters in millimeters for 30 subgroups of 5 items each.

$\overline{X}$	R	$\overline{X}$	R	$\overline{X}$	R
45.020	0.375	45.600	0.275	45.260	0.150
44.950	0.450	45.020	0.175	45.650	0.200
45.480	0.450	45.320	0.200	45.620	0.400
45.320	0.150	45.560	0.425	45.480	0.225
45.280	0.200	45.140	0.250	45.380	0.125
45.820	0.250	45.620	0.375	45.660	0.350
45.580	0.275	45.800	0.475	45.460	0.225
45.400	0.475	45.500	0.200	45.640	0.375
45.660	0.475	45.780	0.275	45.390	0.650
45.680	0.275	45.640	0.225	45.290	0.350

For the first 20 samples set up an $\overline{X}$ chart and an R chart. Plot the next 10 samples on these charts to see if the process continues under control both as to average and range.

10

572

UNIT - III

3 (a) Compare :

(i) p-chart with $\bar{X}$ and R-chart, and

(ii) Variable chart with Attribute charts.

4+4

(b) Samples of fabric from a textile mill, each 100 m^2, are selected, and the number of occurrences of foreign matter are recorded. Data for 25 samples is shown in table below. Construct a C-chart for the number of non-conformities.

Sample	Non-conformities	Sample	Non-conformities
1	5	14	11
2	4	15	9
3	7	16	5
4	6	17	7
5	8	18	6
6	5	19	10
7	6	20	8
8	5	21	9
9	16	22	9
10	10	23	7
11	9	24	5
12	7	25	7
13	8		

8

OR

3 (a) What are the advantages and disadvantages of control charts for attributes over those for variables ?

6

(b) In a manufacturing process the number of defectives found in the inspection of 20 lots of 100 samples is given below :

Lot No.	1	2	3	4	5	6	7	8	9	10
No. of Defectives	5	4	3	5	4	6	9	15	11	6
Lot No.	11	12	13	14	15	16	17	18	19	20
No. of Defectives	7	6	3	5	4	2	8	7	6	4

(i) Determine the control limits of p-chart and state whether the process is in control.

(ii) Determine the new value of mean fraction defective if some points are out of control. Compute the corresponding control limits and state whether the process is still in control or not.

(iii) Determine the sample size when a quality limit not worse than 9% is desirable and a 10% bad product will not be permitted more than 3 times in thousand.

10

UNIT - IV

4 (a) Discuss Quality Audit in detail.

8

(b) Short note :

(i) ISO 9000

(ii) AOQL

4+4

OR

4 (a) What is the importance of the OC curve in the selection of sampling plans ? Describe the impact of the sample size and the acceptance number on the OC curve.

8

(b) Explain the various types of sampling plans which are in practice in industry with their respective acceptance criteria.

8

UNIT - V

5 Discuss Taguchi's philosophy for quality improvement. Discuss his loss function and its contributions.

16

OR

5 (a) Discuss the reliability and life testing in detail.

8

(b) Define reliability. Explain procedures that might improve the reliability of a system. Distinguish between a system with components in parallel and another with standby components.

8

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5E3175

Roll No. : _____ Total Printed Pages : 3

5E3175

B. Tech. (Sem. V) (Mercy Back) Examination, November - 2018
Mechanical Engineering
5ME1(O) Advanced Mechanics of Solids

Time : 3 Hours] **[Maximum Marks : 80**
[Min. Passing Marks : 24

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing 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

UNIT - I

1 At a point P in a body, σ_x = 10,000 N/cm^2, σ_y = –5,000 N/cm^2, σ_z = –5,000 N/cm^2, $\tau_{xy} = \tau_{yz} = \tau_{zx}$ = 10,000 N/cm^2. Determine the normal and shearing stresses on a plane that is equally inclined to all the three axes. **16**

OR

1 (a) Explain the terms (i) Pure shear stress (ii) stress invariants and its property. **8**

(b) Define stress at a point and derive differential equations of equilibrium. **8**

375

UNIT - II

2 Derive the change in length of a Linear Element. **16**

OR

2 Explain the following :

(a) Strain deviator and its invariants. **8**

(b) Plane state of strain. **4**

(c) State of strain at a point. **4**

UNIT - III

3 (a) Derive and explain the generalized Hooke's law. **6**

(b) A cubical element is subjected to the following state of stress : σ_x = 100 MPa, σ_y = –20 MPa, σ_z = –40 MPa, $\tau_{xy} = \tau_{yz} = \tau_{zx} = 0$. Assuming the material to be homogeneous and isotropic, determine the principal shear strains and the octahedral shear strain, if E = 2×10^5 MPa and V = 0.25. **10**

OR

3 (a) Write short notes on isotropy, anisotropy and orthotropy. **8**

(b) Derive stress strain relations for Isotropic materials in terms of Lame's coefficient. (λ and μ). **8**

UNIT - IV

4 What do you mean by curved beam ? Explain in detail the difference between symmetrical bending and unsymmetrical bending. **16**

OR

376

4 (a) Derive Winkler-Bach formula to find bending stresses in initially curved beams.

8

(b) A cantilever beam of rectangular section is subjected to a load of 1000N which is inclined at an angle of 30° to the vertical. What is the stress due to bending at a point D near the built in end ?

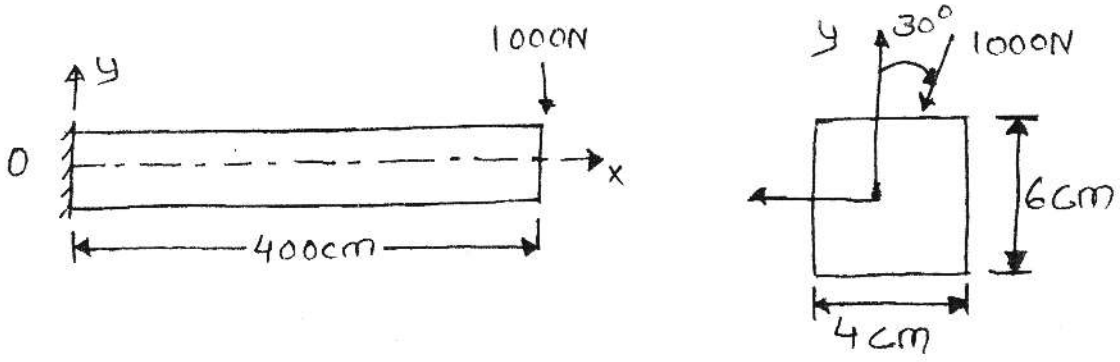

Fig.

8

UNIT - V

5 Derive general expression for stresses of rotating disk having uniform thickness. Also show the stress distribution.

16

OR

5 What are the stresses produced in a thick walted cylinder subjected to internal and external pressure ? Derive the expression for such stresses.

16

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5E6205

Roll No. : _____ Total Printed Pages : 2

5E6205

B. Tech. (Sem. V) (Main / Back) Examination, November - 2018
Mech. Engineering
5ME5A Sociology & Economics for Engineers

Time : 3 Hours] **[Maximum Marks : 80**
[Min. Passing Marks : 26

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing 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

UNIT - I

1 Write short note on Social Stratification. **16**

OR

1 What is globalization ? Discuss its effects on Indian society. **16**

UNIT - II

2 Organization is a key part of social and economic structure. Discuss. **16**

OR

2 Write short notes on :

(i) Tribal society

8

(ii) Urban society.

8

UNIT - III

3 Discuss different forms of market structure.

16

OR

3 Write short note on Aggregate demand and Aggregate supply.

16

UNIT - IV

4 Discuss the role and functions of commercial banks.

16

OR

4 Briefly discuss the tools of monetary policy.

16

UNIT - V

5 Briefly discuss the salient features of Indian economy.

16

OR

5 What is unemployment ? Discuss the reasons and remedies of unemployment in organized and unorganized sectors in India.

16

5E6207

Roll No. : _____

Total Printed Pages : 3

5E6207

B. Tech. (Sem. V) (Main / Back) Examination, November - 2018
Mech. Engineering
5ME6.2 A Automobile Engineering

Time : 3 Hours] **[Maximum Marks : 80**
[Min. Passing Marks : 26

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing 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

UNIT - I

1 (a) Explain the role of chassis with its layout. **8**

(b) What is role of clutch ? How multiplate clutch works ? **8**

OR

1 (a) Explain the constructional feature of chassis. **8**

(b) Classify the brakes and explain their functions. What is use of lining materials ? **8**

379

UNIT - II

2 (a) Explain the constant mesh gear box. **8**

(b) What is differential ? Explain its working process. **8**

OR

2 (a) How power can be transfer with hydraulic torque converter ? Write its advantages over sliding mesh gear box. **8**

(b) Explain the all wheel drive. Write its advantages and disadvantages over front wheel drive. **8**

UNIT - III

3 What is role of steering geometry ? Explain it. **16**

OR

3 (a) Explain the working of power steering. **8**

(b) What is suspension system ? How it can be achieved ? Explain different shock absorbers. **8**

UNIT - IV

4 Explain the starting and battery charging system. What are the general maintenance requirement in this system ? **16**

OR

380

4 (a) What is an alternator ? Explain its construction and working process. **8**

(b) Explain the automotive lighting system and explain its components. **8**

UNIT - V

5 (a) What is air conditioning ? How it can be achieved in an automotive system ? Explain its components. **8**

(b) What are the safety regulations in India for automotive safety ? Explain them briefly. **8**

OR

5 Write short notes on :

(a) Air bags

(b) Night vision system

(c) Global positioning system

(d) Refrigerants.

16

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5E3180

Roll No. : _____ Total Printed Pages : 7

5E3180

B. Tech. (Sem. V) (Mercy Back) Examination, November - 2018
Mechanical Engineering
5ME6 (O) Principles of Turbomachines

Time : 3 Hours] **[Maximum Marks : 80**
[Min. Passing Marks : 24

*Attempt any **five questions**, selecting **one question** from **each unit**. All Questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing 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

UNIT - I

1 (a) Derive an equation of moment of momentum applicable to turbo machines for the calculation of theoretical energy transfer. Transform the equation into the form which consists of centrifugal and other effects. Explain the physical significance of each term and discuss the term degree of reaction. **8**

(b) Using Buckingham's π theorem show that the discharge of a centrifugal pump can be expressed as

$$Q = ND^3 \varphi \left[\frac{ND}{\sqrt{gH}}, \frac{ND^2}{V} \right]$$

where N = speed of the pump

D = diameter of the impeller

v = kinematic viscosity

g = Acceleration due to gravity

H = Head

8

OR

1 (a) Define specific speed (N_S) and Non-dimensional specific speed (k_n) and prove that

$N_S = 1042\ k_n$

3

(b) Define the terms 'unit speed' and 'unit power'. Show that $Ns = Nu\sqrt{P_u}$.

3

(c) An experiment of single stage centrifugal pump was found to operate free from cavitation under a minimum net positive suction head of 4.2 m when pumping water at the rate of 140 liters/s against a head of 39 m. The impeller diameter was 450 mm and speed 1200 rpm.

A geometrically similar impeller is required to discharge 5660 liters/sec. against a head of 120 m. Assuming a water temperature of 20°C and allowing 0.35 m for hydraulic losses, at what speed and suction head should the prototype operate ? Assuming barometric pressure as 760 mm of mercury.

10

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UNIT - II

2 (a) With the help of a neat sketches, explain all the components of a centrifugal pump. Also explain NPSH and Priming in a pump. **8**

(b) Draw the velocity triangles at the inlet and outlet tips of the vane fixed to an impeller and drive an expression for minimum starting speed of a centrifugal pump. **8**

OR

2 (a) Explain the various pump losses and efficiencies in a centrifugal pump. **8**

(b) The outer diameter of an impeller of a centrifugal pump is 40 cm and outlet width is 5cm. The pump is running at 800 rpm and working against a head of 16 cm. The vane angle at outlet is 40°. Assuming the manometric efficiency to be 75%, determine the discharge. **8**

UNIT - III

3 (a) Draw and explain the velocity triangle for axial flow pump. Calculate the degree of reaction and work done. **8**

(b) Define the characteristics curve for the pump selection and performance and obtain the justification of the pumps in parallel and series. **8**

OR

3 (a) An axial flow pump has the following data :

Rotational speed = 750 rpm

Discharge of water = 1.75 m/s

Hub to diameter ratio = 0.45

Through flow velocity is 0.35 times the peripheral velocity.

Find the dia. and minimum speed ratio.

8

(b) Determine the overall efficiency of an axial flow pump from the following data.

Total Head = 22 m

Discharge = 120 m^3/s,

Speed = 1200 rpm

Diameter and width is 0.3 m and 0.05 m

Shaft power is 55 kW,

Vane angle at outlet is 35^o.

8

UNIT - IV

4 (a) An axial compressor has a mean diameter of 60 cm and runs at 15,000 r.p.m. If the actual temperature rise and pressure ratio developed are 30^oC and 1.3 respectively then calculate :

(i) power required to drive the compressor while delivering 57 kg/S, and

(ii) Safe efficiency

8

(b) Define the following :

(i) Prewhirl

(ii) Power Input factor

(iii) Surging, choking and stall

(iv) rotating stall

(v) Slip factor

(vi) Degree of Reaction.

8

OR

4 (a) Draw a neat sketch showing guide vanes and impeller blades and draw velocity diagram at shroud and at hub.

3

(b) Draw graph between radius ratio v/s incedence angle and radius ratio v/s absolute flow angles for various whirl distribution for

n = –1, n = 0, n = 1, and n = 2 where

n = 0 for simple untwisted blade shape

n = 2 free vortex design or quadratic design.

3

(c) Air at a stagnation temperature of 22°C enters the impeller of a centrifugal compressor in the axial direction. The rotor, which has 17 radial vanes, rotates at 15000 rpm. The stagnation pressure ratio between diffuser outlet and impeller inlet is 4.2 and the total to total efficiency is 83%. Determine the impeller tip radius and power required to drive the compressor when the mass flow rate is 2 kg/s and the mechanical efficiency is 97%. Given that the air density at impeller outlet is 2 kg/m^3 and the axial width at entrance to the diffuser is 11 mm, determine the absolute Mach number at that point. Assume that the slip factor $\sigma_s = 1 - \frac{2}{Z}$, where Z is the number of vanes. Take r = 1.4 and R = 0.287 kJ/kg K for air.

10

UNIT - V

5 (a) Explain the working principle of an axial flow compressor. Also draw the velocity triangles for the same and calculate the stage work.

8

(b) An axial blower supplies air to a furnace at the rate of 3 kg/S. The atmospheric conditions being 100 KPa and 310 K. The Blower efficiency is 80% and mechanical efficiency is 85%. The power supplied is 30 kW. Estimate the overall efficiency and pressure developed in mm W.G.

8

OR

5 (a) The data refers to a test on an axial flow compressor are given as :

Atmospheric Temperature and pressure at inlet are 18°C and 1 bar, Total head temp. in delivery pipe is 165°C. Total head pressure in delivery pipe is 3.5 bar.

Static pressure in delivery pipe is 3 bar.

Calculate :

(a) Total head isentropic efficiency

(b) Polytropic efficiency

(c) Air velocity in delivery pipe

8

3&7

(b) How do we calculate ?

(i) Static pressure rise

(ii) Stage efficiency

(iii) Pressure coefficient in an axial flow compressor.

8
