Code No: RT32033 **R13** SET - 1

III B. Tech II Semester Regular/Supplementary Examinations, April - 2017

DESIGN OF MACHINE MEMBERS– II

(Mechanical Engineering)

Time: 3 hours Maximum Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

(Design Data book is allowed)

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PART –A

1	a)	What are journal bearings? Give a classification of these bearings.	[3M]
	b)	Why is one end of the connecting rod bigger than other? What are the most usual causes of crankshaft failures?	[4M]
	c)	What are the design requirements of piston? What is the function of cup shaped cavity in piston head?	[4M]
	d)	Expression of h^2 for I and T sections.	[4M]
	e)	How V-belt drives are designated? Why slip is less in V-belt then flat belts?	[4M]
	f)	State the following (i) Leverage (ii) Load on the lever.	[3M]

PART -B

2		A bearing for an axial flow compressor is to carry a radial load of 2500 N and thrust of 1500 N. The service imposes light shock and the bearing will be in use for 40 hours/week in 5 years. The speed of the shaft is 1000 rpm. Select suitable ball bearing for the purpose and give the required tolerances on the shaft and the housing. Diameter of the shaft is 50mm.	[16M]
3		Design a connecting rod for four stroke petrol engine with the following data. Piston diameter = 0.10 m , stroke = 0.14 m, length of the connecting rod from centre to centre = 0.315 m, weight of reciprocating parts = 18.2 N, speed = 1500 rpm with possible over speed of 2500 compression ratio = 4:1, probable maximum explosion pressure = 2.45 MPa.	[16M]
4		Design a trunk type cast iron piston for a 4-stroke diesel engine with the following specifications: cylinder bore = 250 mm, stroke length = 375 mm, speed = 600 rpm, maximum gas pressure = 5 MPa, indicated mean effective pressure = 0.8 MPa, rate of fuel consumption = 0.3 Kg/BP/H, higher calorific value of fuel = 44 MJ/Kg, mechanical efficiency = 80%. Sate clearly the design decision taken.	[16M]
5	a)	Write and derive the expression for Winkler-Bach formula.	[12M]
	b)	What are the assumptions made in the derivation of stresses in a curved bar.	[4M]

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6 Recommend a flat belt drive for driving a centrifugal pump with 10 KW motor operating continuously at 1750 rpm. The pump speed should be 875 rpm and the centre distance may be from 750 mm to 1000 mm. The preferable distance may be 900 mm. [16M]

7 A lever loaded safety valve is 75 mm in diameter and is to be designed for a boiler to blow-off at a pressure of 1.1 MPa. Design a suitable mild steel lever of rectangular cross-section using the following permissible stresses Tensile stress = 72 MPa. Shear stress = 45 MPa Bearing pressure intensity = 24 MPa
The pin is also made of mild steel, The distance from the fulcrum to the weight of the lever is 900 mm and the distance between the fulcrum and pin connecting the valve spindle links to the lever is 100 mm. [16M]

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Code No: RT32033 **R13** SET - 2

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DESIGN OF MACHINE MEMBERS– II

(Mechanical Engineering)

Time: 3 hours Maximum Marks: 70

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	Differentiate the rated life of bearing with its average life.	[3M]
	b)	What is bearing modulus and its significance?	[4M]
	c)	What are the design criteria for piston pin? Where is piston pin located?	[4M]
	d)	Write down the assumptions in derivation of Winkler Bach formula.	[4M]
	e)	How do you estimate the life of a belt drive? What is the condition for maximum power transmission by a belt drive?	[4M]
	f)	List the use of different types of levers.	[3M]

PART -B

2		A rolling contact bearing is subjected to the following work cycle : (a) Radial load of 6000 N at 150 r.p.m. for 25% of the time; (b) Radial load of 7500 N at 600 r.p.m. for 20% of the time; and (c) Radial load of 2000 N at 300 r.p.m. for 55% of the time. The inner ring rotates and loads are steady. Select a bearing for an expected average life of 2500 hours.	[16M]
3		Design a side or overhung crank shaft for a single cylinder petrol engine having following specifications Size = 500 mm by 600 mm, maximum pressure on piston = 2.1 N/mm^2, l/r = 4.5, shaft material = 40C8 for crankpin bearing assume l/d = 1 and pressure should not exceed 10 N/mm^2. For main bearing assume l/d = 1 and pressure should not exceed 9 N/mm^2. The side crank carries a flywheel whose weight is 40 KN and is in between the two journal bearings which act as main bearing. The distance between the bearing may be taken as 600 mm. The cylinder of the engine is horizontal. The maximum torque on the crank occurs at an angle of 30^0. The pressure at maximum torque is about half of the maximum pressure. Assume any other data.	[16M]
4		The following is the data for a 4-stroke diesel engine. Cylinder bore = 100mm, maximum gas pressure = 5 MPa, Allowable bearing pressure for piston skirt = 0.5 MPa, side thrust on liner to maximum gas load on piston ratio = 0.1, width of top land = 18 mm, width of ring grooves = 2.5 mm, number of piston rings = 4, axial thickness of piston rings = 3mm. Determine the length of skirt and length of piston.	[16M]
5	a)	Find the expression of h^2 for rectangular cross-section.	[8M]
	b)	Find the expression for bending stress produced in a curved bar which is subjected to bending moment.	[8M]

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6 The following data are given for a V-belt drive: design power = 20 KW , diameter of driving pulley = 200mm, speed of smaller pulley = 1120 rpm, velocity ratio = 3, groove angle = 38^0, centrifugal force = 125 N, permissible tension in the belt = 550 N, coefficient of friction = 0.3, angle of contact at smaller pulley = 156^0, centre distance = 2m. Determine the number of belts and the life of the belt. The belt is to be used for 8 hours per day. [16M]

7 The lever loaded safety valve is mounted on the boiler to blow off at a pressure of 1.5 MPa gauge. The effective diameter of the opening of the valve is 50 mm. The distance between the fulcrum and dead weights on the lever is 1000 mm. The distance between the fulcrum and the pin connecting the valve spindle to the liver is 100 mm. The lever and the pin are made of plain carbon steel 30C8 and the factor of safety is 5. The permissible bearing pressure at the pin in the lever is 25 N/mm^2. The lever had a rectangular cross-section and the ratio of width to thickness is 3:1. Design a suitable lever for the safety valve. [16M]

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DESIGN OF MACHINE MEMBERS– II

(Mechanical Engineering)

Time: 3 hours Maximum Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	List any four advantages of rolling contact bearings over sliding contact bearings.	[3M]
	b)	What are different types of cross section used in connecting rod? Which cross section is mostly used and why?	[4M]
	c)	What are the functions of compression piston rings? List the materials used for piston rings.	[4M]
	d)	Write down the assumptions in derivation of Winkler Bach formula.	[4M]
	e)	State the advantages and disadvantages of flat belt drive over V belt drive.	[4M]
	f)	List the factors on which dynamic load factor depends.	[3M]

PART -B

2	Design a journal bearing for a centrifugal pump from the following data: Load on the journal=20000N, Speed of the journal=900rpm, Type of oil is SAE 10, for which the absolute viscosity at 55°C=0.017kg/m-s, Ambient temperature of oil = 15.5^0C, Maximum bearing pressure for the pump=1.5N/mm^2.Calculate also mass of the lubricating oil required for artificial cooling, if the rise of temperature of oil be limited to 10°C heat dissipation coefficient=1232W/m^2/°C.	[16M]
3	Determine the dimensions of a cast iron cylinder, cylinder head, liner and bolts and studs for a four stroke internal combustion petrol engine having the following specifications. Brake power = 7.5 KW, speed = 900 rpm, indicated mena effective pressure = 0.3 MPa, maximum pressure = 10 times of the mean pressure, mechanical efficiency = 0.85. Assume any other data suitably.	[16M]
4	Design a trunk type cast iron piston for a 4-stroke diesel engine with the following specifications: cylinder bore = 250 mm, stroke length = 375 mm, speed = 600 rpm, maximum gas pressure = 5 MPa, indicated mean effective pressure = 0.8 MPa, rate if fuel consumption = 0.3 Kg/BP/H, higher calorific value of fuel = 44 MJ/Kg, mechanical efficiency = 80%. Sate clearly the design decision taken.	[16M]

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5		A central horizontal section of a hook is symmetrical trapezium 90 mm deep. The inner width being 90 mm and outer being 45 mm. The hook carries a load of 67.5 KN, the load line passes at a distance of 40 mm from the inside edge of the section. The centre of curvature is in the load line. Calculate the extreme intensities of stress. Also plot the stress distribution across the section.	[16M]
6		Select a suitable wire rope for a mine hoist carrying a load of 80 KN to be lifted from a depth of 100 m. The speed of 10 m/s should be attained in 10 s.	[16M]
7	a)	Explain the following terms used in helical gears : (i) Helix angle; (ii) normal pitch; and (iii) axial pitch.	[6M]
	b)	A pair of helical gears are to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10 000 r.p.m. and has 80 mm pitch diameter.The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPa; determine a suitable module and face width from static strength considerations and check the gears for wear, given σ_{es} = 618 MPa.	[10M]

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DESIGN OF MACHINE MEMBERS– II

(Mechanical Engineering)

Time: 3 hours Maximum Marks: 70

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

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PART –A

1	a)	What is the procedure followed in designing a journal bearing? For a journal bearing the maximum operating temperature must be less than 80˚C. Why?	[3M]
	b)	Why liners are provided in the cylinder? How distortion of liner can be reduced?	[4M]
	c)	What are the design requirements of piston? What is the function of cup shaped cavity in piston head?	[4M]
	d)	Expression of h^2 for I and T sections.	[4M]
	e)	How are chain drives designated? Define pitch and offset of chain drives.	[4M]
	f)	State the assumptions made in Lewis equation.	[3M]

PART -B

2	A full journal bearing of 50mm diameter and 100mm long has a bearing pressure of 1.4N/mm^2. The speed of the journal is 900rpm and the ratio of journal diameter to the diametric clearance is 1000. The bearing is lubricated with oil, whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35^{0}C.Find, (1) The amount of artificial cooling required. (2)The mass of lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of oil as 1850J/Kg/^{0}C.	[16M]
3	A connecting is required to be designed for high speed four stroke engines. The following data is available. Diameter of piston = 88 mm, mass of reciprocating parts = 1.6 kg, length of connecting rod, centre to centre = 300 mm, stroke = 125 mm, rpm = 2200 (when developing 50 KW), compression ratio = 6.8 :1, probable maximum explosion pressure = 3.5 N/mm^2. Assume any other suitable data. Design the connecting rod.	[16M]
4	The following is the data for a 4-stroke diesel engine. Cylinder bore = 100mm, maximum gas pressure = 5 MPa, Allowable bearing pressure for piston skirt = 0.5 MPa, side thrust on liner to maximum gas load on piston ratio = 0.1, width of top land = 18 mm, width of ring grooves = 2.5 mm, number of piston rings = 4, axial thickness of piston rings = 3mm. Determine the length of skirt and length of piston.	[16M]
5	Determine (i) location of neutral axis, (ii) maximum and minimum stresses when a curved beam of circular section of diameter 60 mm is subjected to pure bending moment of + 1350 Nm. The bottom width is towards the centre of curvature. The radius of curvature is 75 mm and beam is curved in a plane parallel to depth. Also plot the variation of stresses across the section.	[16M]

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6 Select a suitable wire rope for a mine hoist carrying a load of 80 KN to be lifted from a depth of 100 m. The speed of 10 m/s should be attained in 10 s. [16M]

7 a) Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures. [4M]

b) A gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1:2 and r.p.m. of the pinion is 200. The approximate centre distance between the shafts may be taken as 600 mm. The teeth has 20° stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear.Check the design for dynamic and wear loads. The deformation or dynamic factor in the Buckingham equation may be taken as 80 and the material combination factor for the wear as 1.4. [12M]

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